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HOW CAN CROPS BE GROWN WITHOUT POTASH MANURES NEXT YEAR?

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THE possibility that crops may have to be grown without potash manures next season necessitates a careful examination of the whole problem, with a view to finding out the best courses to be adopted in the circumstances.

Potash manures are only of recent use in this country, and they were not imported in any quantity until about 1890. All the good farming of the 'sixties was done without them. Two important potash-needing crops, however, are grown more commonly now than then, viz., potatoes and mangolds, and these have only been possible on our present scale since the introduction of potash manures; the leguminous crops, clovers, lucerne, vetches, peas, beans, etc., also stand in need of much potash. These are the crops that need it most, but they are vitally necessary now, and are almost entirely produced at home, the imports being simply a small proportion of potatoes. How, then, is it possible to arrange a supply of potash for them?

Two methods may be adopted:—(1) Other sources of potash can be used instead of the ordinary Stassfurt salts; and (2) the supplies of potash in the soil can be made available.

Sources of Potash other than Stassfurt Salts.

(*a*) VARIOUS ASHES, ETC.—Numerous efforts have been made in the past to utilise various potash minerals which occur in quantity in different parts of the world outside Germany, but these have not materialised on a large scale, and, in consequence, not one of them is available to help at the present time. Since the war

began, however, attention has been directed to various sources of supply which are or could be brought immediately within the reach of farmers. These sources are included in Table 1.

TABLE 1.—SOURCES OF POTASH OTHER THAN STASSFURT SALTS AVAILABLE ON THE FARM.

Material.	Percentage of Potash (as K_2O).*	Further information is given in :—
Ashes of Seaweed ..	16	This *Journal*, Vol. 17, p. 464.
„ „ Bracken ..	2·5	„ „ Vol. 15, p. 481.
„ „ Hedge trimmings.	10	„ „ Vol. 21, p. 694.
„ „ Waste cavings and waste from threshing ..	8 to 10	„ „ „ „
„ „ Wood waste, sawdust, etc...	5 to 7	Gimingham, Long Ashton, Rpt., 1914.
Flue dust from saw mills	up to 10	„ „ „

* Kainit contains 12 per cent. of Potash as K_2O.

In all these cases except the last the potash is present as carbonate, a very soluble and highly available fertiliser. Its drawback is that it is rather too soluble, so that the ashes have to be kept dry and, above all, carefully shielded from rain, or they may lose half their value in a single night. They can safely be mixed with superphosphate before distribution, and applied at the rate of about 3 cwt. per acre.

Attention having recently been directed in this *Journal* to most of these substances, it is unnecessary to do more than emphasise once again the urgent necessity of preserving them carefully, and, when practicable, of increasing the supplies by collecting hedge trimmings, prunings, dead bracken, and other waste vegetation for burning and conversion into ash.

Seaweed contains so much potash and such good fertilising material generally, that we may yet hope to utilise it better than at present.

(*b*) FARM PRODUCTS.—Farm crops contain considerable proportions of potash, as shown in Table 2. Mangolds easily head the list, a 40-ton crop containing in the roots alone no less than 400 lb. of pure potash, equivalent to 30 cwt. of kainit, while the leaves contain an additional 150 lb. of potash, equivalent to 11 cwt. of kainit. It is evident that the leaves represent a useful source of potash, and should not be wasted; they should be spread evenly on the soil and ploughed in; decomposition rapidly begins, and the potash is set free. They are relatively free from insect and fungoid pests, and there is little if any risk of introducing harmful organisms into the soil to injure the next crop.

Hay shows great variations in potash content according to the richness of the soil in which it is grown. The hay from the Rothamsted unmanured plot contains only 1·25 per cent.; accordingly the whole crop only removes 28 lb. per acre from the soil. On the other hand, the hay from the plots receiving nitrate of soda, superphosphate, potash and other mineral manures, contains 2 per cent. and removes the very large amount of 109 lb. per acre. Ordinary meadow hay comes somewhere between these figures; it contains about 1·6 per cent., and a 30-cwt. crop removes only 54 lb. of potash from the soil per acre.

Table 2.—Approximate Potash Content of Various Farm Products.

Crop or Produce.	Size of Crop per Acre.	Weight of Potash (K_2O) removed per Acre.	Proportion of Potash in the Crop.	Weight of Potash in 1 ton of Crop.	Approximate weight necessary to furnish as much Potash as 4 cwt. of Kainit.
		lb.	Per cent.	lb.	tons.
Mangolds, roots ..	40 tons.	400	0·45	10	$5\frac{1}{2}$
,, leaves	15 ,,	150	0·45	10	$5\frac{1}{2}$
Turnips, roots ..	20 ,,	110	0·25	$5\frac{1}{2}$	10
Potatoes, tubers..	8 ,,	108	0·6	$13\frac{1}{2}$	4
Clover hay ..	2 ,,	68	1·5	34	$1\frac{1}{2}$
Hay from well-manured land*	$2\frac{1}{4}$,,	101	2·0	45	$1\frac{1}{4}$
Hay from unmanured land†	1 ,,	28	1·25	28	2
Ordinary meadow hay	$1\frac{1}{2}$,,	54	1·6	36	$1\frac{1}{2}$
Oats, grain ..	60 bushels (2,400 lb.)	12	0·5	11	5
Oats, straw ..	32 cwt.	36	1·0	22	$2\frac{1}{2}$
Wheat, grain ..	40 bushels (2,480 lb.)	12	0·5	11	5
Wheat, straw ..	36 cwt.	32	0·8	18	3

* Rothamsted Park hay. Plot 16 (mixed mineral manure and nitrate of soda).

† Rothamsted Park hay, unmanured. Analytical data given in Phil. Trans., 1900, Vol. 192, p. 199.

The potash in these crops is drawn partly from the original stock in the soil, and partly from purchased manures and feeding stuffs. If the crops are sold off the land, the potash is entirely lost to the farm, but more usually the mangolds, turnips, and part of the hay and straw are consumed on the farm. It is interesting to notice that these—the hay and root crops—contain by far the greatest proportion of potash. With the striking exception of potatoes, the crops sold off do not remove much potash, grain in particular taking away relatively very little. This shows how

little justification there is nowadays, so far as the supply of potash is concerned, for restrictions on freedom of sale of straw, or on taking two white straw crops in succession.

Where the crops are consumed on the farm, a certain proportion of the potash finds its way into the manure, and so back to the land. It thus keeps circulating between the soil, the crop, the animal and the manure heap, and we must now enquire what losses arise during the process, and how they may be stopped.

Potash Retained by Live Stock.—Potash is less retained by live stock than any other ingredient of manurial value in their food. This was demonstrated in 1883 by Lawes and Gilbert,* when they worked up the detailed analyses of the ashes of the animals slaughtered during their famous experiments of 1849-50.† The increase of weight during fattening was found to contain 1·27 per cent. of nitrogen, 0·86 per cent. of phosphoric acid, but only 0·11 per cent. of potash; in other words, for every hundredweight of flesh laid on, a fattening animal retains only 2 oz. of potash.

Milch cows naturally retain more. Milk contains about 0·17 per cent. of potash, so that 100 gal. contain approximately $1\frac{2}{3}$ lb. Generally speaking, milch cows retain about 10 to 15 per cent. of the potash present in a normal mixed diet, but Lawes and Gilbert calculated that a higher proportion is retained in the case of certain concentrated foods.‡

The Amount of Potash Passing into the Manure.—About 90 per cent. of the potash present in the animal's food is assimilated and passes into the animal's circulation. It has been shown above that the animal does not keep it. What then happens to it? The answer is that it is excreted in the urine, in which form it is a highly available fertiliser. Some interesting experiments were made on this subject by Sweetser at the Pennsylvania State College Experiment Station§ in 1899, two cows being tested over five periods of 40 days each. During the last ten days of each period the cows were put upon digestion trials, and a careful record was kept of the amount and composition of the food eaten, and of the milk and the excretions. For the 50 days of these observations the results (added together) for the two cows were as follows:—

* Phil. Trans., 1883, pp. 865–890. The application of these results to the problem of evaluating unexhausted manures is made in Jour. Roy. Agric. Soc., 1885, Ser. ii, Vol. 21, pp. 590–611.

† Phil. Trans., 1859, pp. 493–678; the results are discussed also in Jour. Roy. Agric. Soc., 1860, Ser. i, Vol. 21, pp. 433–488.

‡ Jour. Roy. Agric. Soc., 1898, Ser. iii, Vol. 9, pp. 103–117.

§ Pennsylvania State College, Annual Rept., 1899–1900: also Bull. No. 54, 1900.

	Quantity.	Potash.		Phosphoric Acid.		Nitrogen.	
		Amount present.	Proportion of total excreted.	Amount present.	Proportion of total excreted.	Amount present.	Proportion of total excreted.
	lb.	lb.	Per cent.	lb.	Per cent.	lb.	Per cent.
Milk ..	2279·4	4·5	10	4·7	23	11·4	17
Fæces (fresh)	4567·4	7·1	15	15·5	75·5	21·5	31
Urine ..	2680·6	34·2	75	0·3	1·5	36·1	52

It does not appear that more recent experiments have been made, but there is no reason to doubt the general result. The high content of potash is characteristic of urine, and is one of the reasons why special care should be taken to save it at the present time. There are three ways in which this can be done: (1) by using enough litter to soak it up, (2) by protecting the manure heap against loss, and (3) by adopting suitable means of collecting it.

Losses from the Manure Heap.—Farmyard manure contains its potash in two forms: the soluble compounds coming from the urine, and the insoluble compounds present in the litter. The sum of the two amounts to about 15 lb. of potash per ton of manure, or rather more than the quantity found in 1 cwt. of kainit or $\frac{1}{4}$ cwt. of sulphate of potash. The soluble part is liable to considerable loss by washing and drainage unless the heap is adequately protected from heavy rainfall.

At Rothamsted the following losses were found to occur:—

	Heap sheltered from rain, drainage at a minimum.	*Heap exposed to rain, considerable drainage.*
Potash originally present in heap, lb.	147	175
Potash left after three months' storage .. .. lb.	130	123
Potash lost .. .. .. lb.	17	52
„ „ per cent. of total ..	12	30

The liquid draining away from the heap contains the potash; if it is carefully kept the loss is less serious. Hendrick* has recently shown that on an average it contains 0·46 per cent. of potash, or 300 gal. contain about as much as is present in 1 cwt. of kainit, and in an admirable state of availability. Good results were obtained by applying it to grass land.

It appears, then, that the waste of potash on the farm need not be great. The chief points of leakage are the cattle yard and

* N. of Scotland Coll. of Agric., Bull. No. 19, 1915 (see this *Journal*, July, 1915, p. 346).

the manure heap, and the chief way in which loss arises is through wastage of the urine and of the brown liquid draining away from the manure. If these sources of loss are stopped, the circulation of potash between the soil, the crop, and the manure heap can be kept up without much loss.

It is now clear why potash did not enter more largely into the scheme of manuring on British farms prior to the more extended cultivation of the potato. A farm worked on the old four-course rotation, and selling only grain and meat, can be made largely self-supporting in the matter of potash supplies if the manure heap is properly managed and the liquid manure is preserved. The bulk of the potash taken up by the cereal crop remains in the straw and does not pass into the grain: thus, so long as the straw is kept on the farm the supply is only slowly exhausted. Fattening and milking cattle only retain a small part of the potash supplied in the food, even a milch cow only passing some 10 per cent. into its milk; all the remainder goes out in the excretions. Even at the present day many farms are still largely self-supporting in this respect, though this does not in any way mean that the farmer need not concern himself with the matter; on the contrary, it gives him an added responsibility, because the parts of the crop containing potash are just those as to which least care is usually exercised and of which most waste is commonly seen.

(*c*) RESIDUE OF PREVIOUS CROPS, ESPECIALLY CLOVER LEYS, GRASS LAND, ETC.—A certain proportion of the potash taken up by plants is retained by the root system, and becomes available to the next generation of plants when the roots begin to decay. It is difficult to ascertain precisely what quantity thus becomes available when grass land and clover leys are ploughed up, but it must be considerable. The old estimates, made in 1869 by Weiske and Werner at Halle, showed that from 40 to 80 lb. of potash (K_2O) and 120 to 190 lb. of nitrogen were left in each acre of roots and residues of clover crops. The figures obtained by Woods in Connecticut, and more recently by Hotter, Herrmann and Stumpf in Austria, are given in Table 3.

These estimates are in the nature of things incomplete, because they take no account of the roots which have decayed. Further, Dr. Cyril Hopkins, of Illinois, has adduced evidence that the decay of clover roots increases the solubility of the potassium minerals in the soil, and any such action would make the estimates still more incomplete. It is, therefore, safe to regard them as minimum estimates only. Numerous field experiments show the

TABLE 3.—ESTIMATED AMOUNTS OF POTASH, PHOSPHORIC ACID AND NITROGEN, LEFT IN THE SOIL BY THE ROOT RESIDUES OF VARIOUS CROPS: LB. PER ACRE.

Crop.	Potash (K_2O).			Phosphoric Acid (P_2O_5).			Nitrogen (N).		
	*Weiske and Werner.	†Woods.	‡Hotter, Herrmann and Stumpf.	*Weiske and Werner	†Woods.	‡Hotter, Herrmann and Stumpf.	*Weiske and Werner.	†Woods.	‡Hotter, Herrmann and Stumpf.
Red Clover ..	82·5	—	35·5	75·4	—	52·7	193	—	158
Lucerne ..	37	—	128	40	—	104·5	137	—	271
Sainfoin ..	43	—	—	30	—	—	124	—	—
Wheat ..	18·6	—	18	10	—	21	24	—	69
Oats	25	—	35·5	30	—	27·3	27	—	64
Buckwheat ..	9·3	3·8	—	11	1·3	—	48	4·4	—
Timothy and Red Top in top 3 feet. ..	—	55·8	—	—	25·2	—	—	90·0	—
Timothy and Red Top in top 6 inches ..	—	53·3	—	—	23·8	—	—	83·7	—
Old grass land..	—	—	44·5	—	—	34·5	—	—	143

* H. Weiske, Werner, E Schmidt and E. Wildt, *Landw. Versuchs-Stat.*, 1871, Vol. 14, 105.
† C. D. Woods, *Storrs School Expt. Station, Conn. Ist. Rept.*, 1888, 28–43.
‡ Ed. Hotter, E. Herrmann and J. Stumpf, *Zeits. Landw. Versuchs. Oesterreich*, 1911, 14, 152–174.

great manurial value of these residues on the succeeding crop. Three only need be quoted, all from Hoosfield, Rothamsted; they are given in Table 4:—

TABLE 4.—EFFECT OF ROOT RESIDUES FROM LEYS ON THE SUCCEEDING CEREAL CROPS.

	Barley, Hoosfield 1906.			Wheat 1899.		
	After Clover ley.	After Barley.		After Sainfoin ley (Hoosfield).	After Wheat (Broadbalk).	
	No manure.	No manure.	Complete artificials.*	No manure.	14 tons dung.	Complete artificials.*
Grain, bush. per acre	36·2	11	52	45·25	42·5	31·25
Straw, cwt. per acre	25·6	6·5	26·5	50	52·5	40·4

* Including 400 lb. ammonium salts in both cases.

	After Lucerne ley, three crops in succession without manure. Hoos leguminous plots.		After Fallow, 1912. Complete Artificials each year. Hoosfield permanent barley plots 4 A.	
	Grain. bush.	Straw. cwt.	Grain. bush.	Straw. cwt.
1912 Oats ..	51	29·5	No crop.	
1913 Barley ..	55	26·5	61	30
1914 Barley ..	33	18	33	19

These results are, of course, only in part attributable to the potash, or even to the nitrogen, but they are significant in view

of the suggestion to plough up poor grass land and bring it again into arable cultivation. The indications are that such land would stand less in need of potash manure than ordinary arable land.

Methods of Rendering the Potash Reserves in the Soil Available.

Although potassium fertilisers are easily soluble in water, they do not readily wash out from the soil, because they become absorbed or fixed by some of the soil constituents. Wherever high farming has been practised, and large quantities of potash salts, stable manure, or feeding stuffs have been imported on to the farm, the amount of potash supplies may well have been greater than the amount removed by the crop. A certain accumulation has therefore taken place in the soil, forming a reserve which can be drawn upon in the present emergency. The process is essentially one of liquidating capital, and if persisted in for many seasons might have bad effects, but as a war measure no harm need be anticipated.

Two general methods may be adopted: (1) dressings of sodium salts may be applied, such as agricultural salt or sulphate of soda, or (2) the land may be limed. Both processes liberate some of the locked-up potash, but they show certain differences that require discussion.

The use of salt or sulphate of soda as a liberator of potash has long been recognised by agricultural chemists. At Rothamsted sodium salts are successfully used on wheat and on mangolds, and analysis shows that they increase the availability of soil potash to the plant.

TABLE 5.—EFFECT OF SODA IN CAUSING THE LIBERATION OF POTASH FROM THE SOIL (ROTHAMSTED).

——	Wheat, Broadbalk field, 1852–1871.			Mangolds, Barnfield 11 years, 1903–1914.*
Manurial Treatment.	Yield of Grain per acre.	Yield of Straw per acre.	Total Potash taken by Crop in the 20 years per acre.	Yield per acre.
	bush.	cwt.	lb.	tons.
Ammonium salts only	26	23	540	6·9
Ammonium salts + Super.	28	26	569	7·1
Ammonium salts + Super. + Sulphate of Soda	34	32	832	23·8
Ammonium salts + Super. + Sulphate of Potash	34	34	1,084	23·0

* 1908 omitted, as swedes were grown instead of mangolds. Rape cake formed part of the dressing in each case.

Examination of the plant and experiments with the soil all bear out the results of analysis, and show that the soda has liberated some of the reserve of potash from the soil, and made it more available to the plant.

There must, however, be some other effect produced by sodium salts, because they are beneficial in water cultures whenever the supply of potash is low; and here, of course, there is no question of increasing the solubility of the potash salts. It must, therefore, be supposed that sodium salts are directly useful to the plant, and will fulfil some of the functions of potassium salts, thus eking out a small supply and enabling the plant to make the most of it.

These conclusions have been strikingly verified in an extensive investigation begun by Dr. Wheeler at the Rhode Island Experiment Station of the United States in 1894,* and continued by his successor Dr. Hartwell and his colleagues, the whole forming perhaps the most complete investigation yet made on the subject.

Forty-eight plots were laid out, some receiving a full application of potash, while others had $\frac{3}{4}$, $\frac{1}{2}$, or $\frac{1}{4}$ of the full amount with certain proportions of soda, and others again received no potash at all. A mixture of phosphates and dried blood was applied to all, and a variety of crops was grown. The experiment was continued year after year. Detailed analyses were made in 1906, and the results are fully discussed in the Report for that year;† they have been summarised also in 1913.‡ The sodium salts materially increased the yield of certain crops when the supplies of potassium salts were reduced. They also affected the composition, causing an increase in the percentage of phosphorus in the plant, though this did not appear to be the cause of the increased yield. They seemed to have little or no consistent effect on the percentages of lime or magnesia, or on the ratio of these two substances. They caused no consistent increases in the percentage of potash in the crops, but in some cases even a decrease; the total amount in the whole crop, however, was almost always increased, showing that the soda had increased the supply of potash to the crop. Typical results are given in Table 6. Evidence was also adduced from water culture experiments to show that the soda enabled the plant to utilise more economically the potash it had taken from the soil.

* Wheeler, *Rhode Island Expt. Sta. Report*. 1894, pp. 168–182.

† Wheeler, Hartwell, Kellogg & Steel, *Rhode Island Expt. Sta. Report*, 1906, pp. 186–316.

‡ Hartwell & Wessels, *Rhode Island Expt. Sta. Bull.* No. 153, 1913 (see this *Journal*, August, 1914, p. 441).

Table 6.—Sodium Salts in partial replacement of Potassium Salts as Fertilisers (Rhode Island).

	Turnips, 1905.		Radishes, 1905.		Mangolds, 1899.	
Potash ration	1	1	1	1	1	1
Soda ration	½	1	½	1	½	1
Green weight per plot, lb.	246	372	375	398	421	682
Dry matter contains :—						
Nitrogen, per cent. ..	3·28	2·67	3·87	3·87	1·63	1·75
Phosphoric acid (P_2O_5), per cent.	1·30	1·39	1·03	1·16	·24	·32
Potash (K_2O), per cent.	2·03	2·94	3·21	2·60	1·24	·84

There is one further point that may me commended to experimenters, although it is not yet ripe to bring before farmers. Certain minerals are obtainable which contain potash in a state of rather low availability, *e.g.*, phonolite, certain feldspars, etc., some of which have been subjected to a considerable number of field trials without, however, giving any consistently definite result. It is possible that if mixed with salt they might prove more useful.

The various experiments recorded in the preceding paragraphs afford satisfactory evidence that sodium salts will enable the plant to carry on without potash fertilisers for a season or two, but before this method can be recommended to farmers it is necessary to enquire whether the sodium salt has any detrimental effect on the soil or the crops.

Salt is often said to have a bad physical effect on soils, but there is nothing to indicate that it is any worse than kainit; and this, as is well known, only becomes objectionable when used in large quantities on heavy soils. Further, any tendency to stickiness can be diminished by the use of superphosphate or sulphate of ammonia.

Mangolds.—All experiments show that the mangold responds to dressings of salt, and there is reason to suppose that for a season or two salt could replace most of the potash usually given.

The crop would not be entirely deprived of potash, for a considerable quantity is contained in the dung invariably applied, and the experiments already described make it reasonably certain that the salt would cause this to be economically used. Numerous English experiments in addition to those at Rothamsted (Table 5) have proved the value of salt. At Woburn*

* *Jour. Roy. Agric. Soc.*, 1908, Vol. 69, p. 355.

Voelcker obtained good results from dressings up to 6 cwt. per acre. His figures are given in Table 7.

Table 7.—Mangolds, Warren Field, 1908.

Produce of Roots, tons per acre.

Nitrate of Soda ..	None.	1 cwt.	1 cwt.	1 cwt.	1 cwt.	1 cwt.
Salt	None.	None.	1 cwt.	2 cwt.	4 cwt.	6 cwt.
Sugar Mangolds ..	28·0	30·2	31·3	34·4	34·7	33·9
Golden Tankard ..	19·9	23·4	23·9	29·4	28·9	33·5
Yellow Globe	28·2	33·2	34·9	38·0	38·3	41·2
Long Red	31·8	36·6	32·3	35·2	36·6	36·6

All plots received a standard dressing of 12 tons of farmyard manure, 3 cwt. of superphosphate, and 1 cwt. of sulphate of potash per acre.

In Northumberland, Gilchrist* found that an application of 2 cwt. of salt per acre was beneficial, increasing the yield by some 4 tons per acre. Milburn and Gaut† in Lancashire obtained good returns from 1 cwt. salt. Foulkes'‡ experiments at the Harper Adams College with dressings of $2\frac{1}{2}$, 5, 10 and 15 cwt., respectively, of salt per acre gave the interesting result that the more salt was used the better was the crop, whilst neither the dry matter nor the sugar content of the roots was adversely affected. This last point has been investigated in some detail in Central Europe in the case of sugar beets. The Austrian investigators, Strohmer, Briem, and Fallada,§ obtained increases both in yield and sugar content when sugar beet was manured with salt. So also Andrlik and Urban,¶ and also Mette,** all in Bohemia, found that salt increased the yield without lowering the sugar content: in one experiment the percentage of sugar in the control crops was 20·6, while in the crops treated with salt it was 21·5.

Cereals.—Generally speaking, no potash manure is applied to cereals, but the high prices now obtaining justify more liberal manuring than has often been practised in the past. Wherever land is known to benefit from potash fertilisers a dressing of salt may be tried. Such dressings were not uncommon in the old days of high prices, and their effect is shown in the Rothamsted

* Cockle Park, Bull. 16, 1911, gives 5 years' results. Later results are given in subsequent bulletins.

† Lancashire C.C. Farmers' Bull. No. 19, 1911.

‡ Harper Adams College Report, 1909, p. 14.

§ Oesterr-Ungar. Zeitsch. Zuckerind., 1908, Vol. 37, p. 763.

¶ Zeitschr. Zuckerind. Böhmen, 1909, Vol 33, pp. 477–485.

** Ibid., pp. 620–621.

experiment quoted in Table 5 (p. 400), where a dressing of sulphate of soda was for many years practically as effective as sulphate of potash, although greater differences subsequently set in. No other British experiments appear to have been recorded. In Yorkshire 2 cwt. of salt per acre added to a complete manurial dressing gave no increase in yield of barley,* but the effect of using salt in place of potash was not tried.

Leguminous Crops.—No large scale experiments appear to have been made to test the effect of sodium salts on leguminous crops, and in the absence of definite information it would not be safe to recommend their use as a means of economising potash supplies; indeed, there is an opinion among practical men that salt is actually harmful to young clover and grasses.

Recourse must therefore be had to another method of setting free the potash reserves, and to this end dressings of lime up to 1 ton per acre, or chalk up to 30 tons per acre, may be used. This method has the further advantage that the lime or chalk acts beneficially in other directions: it keeps the soil in good mechanical condition during winter so that the young plants are not killed by excessive water, and it also prevents "sourness," a condition highly detrimental to leguminous plants generally, and to clover in particular.

The effect of the lime, or chalk, is very marked; often, indeed, it enables a good plant to be secured where otherwise the crop would fail. At Rothamsted the chalked plots this year gave 37½ cwt. of clover hay, while the unchalked gave only 19½ cwt., containing much more weed and grass.

On arable land such dressings may liberate all the potash needed, especially where fairly liberal supplies have been given in the past in the form of potash salts or of farmyard manure.

The method, however, does not always succeed on grass land, especially meadow land that has been persistently hayed. Neither lime nor chalk can take the place of potash; they can only set it free from certain insoluble combinations if it is present in these forms. Where the potash supplies are already very low, there is so little to set free that neither lime, chalk, nor sodium salts have any great chance of being effective. This is shown in the results given in Table 8 for the Park at Rothamsted, where the grass has been cut for hay every year since 1856, and where, therefore, some of the plots have been considerably exhausted. Plot 8, which is poor in potash, is not benefited by lime, while Plot 7, which is better off in this respect, is improved considerably.

* Leeds University, Bull. No. 75, 1909.

Table 8.—Yield of Hay on the Park at Rothamsted.

Mean of 10 Years, 1904–1913.

Plot.	Manuring.	Yield per acre.	Botanical Composition.		
			Gramineae.	Leguminosae.	Other Plants.
		cwt.	per cent.	per cent.	per cent.
4-1	Superphosphate only	18·7	50·6	8·7	40·7
8 N.	Superphosphate + sodium and magnesium salts	23·5	41·6	11·7	46·7
8 S.	Superphosphate + sodium and magnesium salts + lime ..	20·9	49·6	14·4	36·0
7 N.	Superphosphate, potash, sodium and magnesium salts ..	36·8	57·3	20·5	22·2
7 S.	Superphosphate,potash, sodium and magnesium salts + lime	42·8	54·0	30·9	15·1

In such cases potash has to be applied, and this must be done by utilising one of the devices given in the first section of this article: by feeding on the land mangolds or other food-stuffs containing potash; by applying farmyard manure if it can be spared, or some of the ashes or even waste cavings if it cannot; or else by using liquid manure. Hendrick has shown in his recent report* that dressings of liquid manure considerably increased the yield of grass without in any way depressing the clover; indeed, in several of the experiments the clover was markedly benefited.

Potatoes.—In view of the great importance of this crop, it is unfortunate that no reliable method exists for dispensing with potash in the fertiliser scheme. The light loams, the gravels and sands on which potato growing has developed so much in the last twenty years are typically poor in potash, and indeed the industry has only been possible on its present scale since the potash fertilisers came into general use. Most potato growers have probably got a certain reserve of potash stored up in the land, but it is not at all clear how this is best liberated. Lime would do it, but there is a persistent belief among growers that lime encourages scab, and whether true or not it is sufficiently widespread to put this particular method out of the question. Salt or sodium sulphate would also serve the purpose, but it is not clear whether any harmful effect would be produced on the potato. A few experiments have been made, but not in this country. Pagnoul† many years ago found that sodium does

* N. of Scotland Coll. of Agric., Bull. 19, 1915.

† Compt. Rend., 1875, Vol. 80, p. 1010.

not actually get into the tuber, so that no direct injury from this source need be anticipated, but the possibility of indirect effects still remains. Hartwell and Wessels,* in the Rhode Island experiments already mentioned, found that potatoes manured with sodium instead of potassium salts were less mealy when cooked and also contained less ash and more nitrogen. Whether the effects would be of any material significance is uncertain. The fact that many growers use kainit for potatoes suggests that salt could be used without likelihood of harm. Until the actual experiment is tried, however, there is an element of risk, and growers will probably do best to put all the potash fertilisers they can get on to their potatoes, and to supplement them with ashes from hedge trimmings, prunings, etc., as suggested on p. 393.

Conclusion.

The continued lack of potash may be met in two ways:—

(1) Greater care must be taken of the sources of potash already available on the farm: wood ashes, damaged straw, mangold and other leaves, liquid manure, etc., which are often allowed to waste in normal times. These contain considerable quantities of potash which, in the aggregate, would help materially in coping with the present shortage. Moreover, the ploughing up of leys and grass land leads to the liberation of the potash stored up in the roots, stems, and leaves, causing it to become available for the next crop.

(2) On most well-managed farms there are supplies of potash in the soil which can now be made available. Two agencies may be adopted: (*a*) sodium salts, especially salt and sodium sulphate, and (*b*) lime or chalk. The former can be used for mangolds and for cereals when necessary; lime and chalk are more suitable for leguminous crops, clover, etc. There might be some risk in using either for potatoes, and growers would probably do best to put all their supplies of potassium salts on this crop.

Neither lime nor salt actually *supplies* potash, and the method only works where potash is already stored up in sufficient quantity in the soil. On meadow land poor in potash it may prove better to apply liquid manure, as is often done successfully in the North.

† Rhode Island Expt. Sta. Bull. No. 153, 1913.

VILLAGE WAR FOOD SOCIETIES.

IT is probable that the most successful means of increasing the production of all classes of foodstuffs, other than those which can only be produced on small or large holdings, would be the formation of what might be termed "Village War Food Societies." This title is suggested as useful, without reference to "cultivation," because it will cover the *utilisation* and *consumption* of foods as well as their production.

Such societies might often be amalgamated (at any rate for the period of the war) with the local gardening and allotment societies, and they might in some cases cover a group of villages. Even where there are allotments the workers can commonly cultivate much more land than they have, and the necessity and desirability of producing more food of all kinds should be impressed upon each village as a unit. The interest of the women and children should be especially enlisted, as their aid will be of very great importance to the success of any operations undertaken.

Formation.—The formation of a society might be brought about by the Clerk to the Parish Council, who might call a meeting of local residents interested in gardening, pigs, poultry, bees, etc., for the purpose of considering the question of the formation of a local society. This being decided upon, a small committee should be elected (with chairman, secretary, and treasurer of the society) to organise the work of the society on a business footing.

Objects.—The object of each society would be to ascertain the position of vacant building plots, uncultivated "waste" areas, and even some common land; discover the owners and secure permission to cultivate such land (if possible, without charge to the society); arrange either for co-operative and mutual cultivation of the land so secured, and ownership of the produce, or parcel it out to the members to cultivate for themselves individually; secure manures, seeds, plants, stock, foodstuffs, and implements on a co-operative basis, and sell or preserve for home use the produce of their labours.

Advice.—In practically every village sufficient expert knowledge exists to enable the work to be undertaken effectively, but if advice is desired as to the formation of societies a communication may be addressed to the Secretary, Board of Agriculture and Fisheries, Whitehall Place, London, S.W., or the Secretary, Agricultural Organisation Society, Queen Anne's Chambers, Westminster, London, S.W. Advice may also be obtained through the means outlined in Special Leaflet No. 25

(*Technical Advice for Farmers*); expert advice may be secured in many counties which employ an agricultural and horticultural staff by applying to the County Education Secretary.

Again, leaflets on the growing of vegetables and fruit, pig-keeping, poultry-keeping, rabbit-keeping, bee-keeping, the bottling and preserving of fruit, storage of vegetables, preservation of eggs, etc., can be obtained free of charge and post free on application to the Board of Agriculture and Fisheries. Further, there are in most districts capable gardeners and breeders of small stock (pigs, rabbits, poultry, and bees), both professional and amateur, who would be glad to give the benefit of their experience to persons who require help in this way.

Rules.—A short, concise set of simple and plain rules should be drafted, based on whether the cultivation of the plots is to be individual or co-operative as regards produce. If the work were to be co-operative and mutual all through, the produce would be divided in proportion to the labour and interest of the individual or be pooled and shared equally by the members. Again, actual cultivation might be individual, but seeds, stock, etc., might still be supplied on a co-operative basis. In any case the members would have to subscribe a small sum to get the society started and place it on a secure footing.

In relation to the objects of the societies, they might concern themselves with the lines of production outlined below:—

Growing of Vegetables.—Land should be got ready as outlined in Special Leaflets Nos. 1 (*Suggestions to Allotment Holders for Autumn Treatment of Land*) and 26 (*Suggestions to Allotment Holders for General Cropping during the Spring and Summer Months*), and sowing and planting of the more suitable vegetables should proceed as therein suggested. Potatoes are dealt with separately in Special Leaflet No. 18 (*Potato Growing in Allotments and Small Gardens*), and *The Cultivation of Onions* in Leaflet No. 264. The best means of buying and using the different kinds of manures are fully considered in three leaflets—No. 72 (*Purchase of Artificial Manures*), No. 80 (*Use of Artificial Manures*), and No. 93 (*Farmyard Manure*), and their special application for market garden crops in Leaflet No. 106 (*Fertilisers for Market Garden Crops*).

The land should be thoroughly prepared, bastard-trenched if possible, well manured, limed if necessary (see Leaflet No. 170—*The Use of Lime in Agriculture*), kept thoroughly clean, by hoeing (see Leaflet No. 112—*Weeds and their Suppression*), and the crops used or marketed directly they are ready, or stored for use as desired. (See Special Leaflet No. 15—*Harvesting and Storing of Garden Vegetables.*)

Goat-keeping.—In rural districts there is usually scope for the keeping of goats, which may be housed and fed fairly cheaply. If care is used in their selection and treatment, they will yield a good return in the form of wholesome milk for the owners. Co-operation among members of a village society may have excellent results in connection with goat-keeping. An article on goat-keeping was published in the *Journal of the Board of Agriculture* for March, 1908, and the Board propose shortly to publish a further article and issue a leaflet on the subject.

Pigs.—In connection with many cottage gardens, and on vacant areas, pig-keeping could be practised much more commonly than at present, and the society should endeavour to increase the local output of pigs. Pig-keeping could readily be conducted on a co-operative basis, and there would be large quantities of waste vegetable matter which would be of very great value for this purpose. Notes which would be of use to the members of the society in connection with the rearing of pigs are given in Special Leaflet No. 10 (*Pig-keeping for Cottagers and Small Holders*).

Poultry.—Every additional egg, and every extra chicken reared will help the food supply, if produced under proper conditions, and there is at the present time special need to increase the numbers of both eggs and poultry. Any reduction in the laying or breeding stock of poultry kept is against the best interests of both the individual and the nation, and each society should do all it can to extend poultry-keeping in its district—again, either by individuals or collectively by co-operation. The number of persons who could readily keep poultry is very great, and a few birds kept by each would not only enable them to utilise much household and garden "waste," but to utilise it in the economic production of eggs and table birds, and add to the resources of the country. The Board have issued a number of leaflets on poultry, and attention may be drawn to Special Leaflet No. 3 (*Poultry on Allotments and Garden Plots*), Special Leaflet No. 2 (*Notes on Poultry Feeding*), Special Leaflet No. 11 (*Poultry Houses and Appliances for Allotment Holders, Cottagers and others*), Leaflet No. 114 (*Feeding of Poultry*), Leaflet No. 129 (*Winter Egg Production*), Leaflet No. 201 (*The Marketing of Poultry*), and Special Leaflet No. 13 (*Marketing of Eggs*).

In some districts where there are fairly large areas available, such as commons, it may be possible to take up the co-operative rearing of turkeys (see Leaflet No. 229—*The Breeding and Rear-*

ing of Turkeys) and geese (see Leaflet No. 198—*Rearing and Marketing of Geese*), while ducks can even more commonly be bred and fattened (see Leaflet No. 167—*Ducks and Duck Breeding*). Suggestions for co-operative effort are made in Leaflet No. 111 (*Co-operative Egg and Poultry Societies*).

Preservation of Eggs.—While it may often be desirable and profitable to sell the eggs produced when new-laid, the societies may usefully consider whether their members cannot act in concert, purchase jars and materials in bulk and preserve eggs for future use. By this means it may be possible for a small district or village to put by some thousands of eggs during the "cheap" season for use when eggs are dear, and so save the meat bill. The more useful means by which eggs may be preserved are described in Leaflet No. 83 (*Preservation of Eggs*).

Rabbit Breeding.—There is plenty of opportunity in every village for increasing the food supply by means of rabbit breeding, the produce being utilised either for home consumption or for increasing home resources through the medium of the market. Some notes on *Utility Rabbit Breeding for Small Holders* are given in Leaflet No. 265, and the Board propose to issue a second leaflet on the subject at an early date.

Pigeon Breeding.—A further means of increasing production lies in the breeding of young pigeons. Little equipment is necessary—none that cannot readily be found in every village, as cotes and wire enclosures can be made by any man who is handy with tools. The birds need little attention if they can be allowed their freedom, and will rear several brace of youngsters annually. The "squabs" may be killed at about 8 weeks old, and before that time is up the old birds will be incubating a further pair of eggs. The Board hope to issue shortly a leaflet on the breeding of utility pigeons.

Bees.—There is always a satisfactory outlet for good honey, which is a valuable article of food, and it should be especially welcome at a time when sugar is so dear. The Village War Food Society might very usefully endeavour to extend bee-keeping in the district. Apart from the fact that, so long as freedom from disease can be secured, the production of honey is an inexpensive and remunerative village industry when the honey is for sale, the honey may, if retained for home use, effect a considerable saving in sugar. Bee-keeping is dealt with in two of the Board's Leaflets, No. 128 (*Advice to Beginners in Bee-keeping*) and No. 141 (*Preparation of Honey for Market*). Co-operative bee-keeping would almost certainly be of value, and could be more economi-

cally and successfully conducted than individual work. Hives placed in separate gardens could still remain part of a co-operative plan, and the running, packing and marketing of the honey could be done at one house and with one set of appliances, while the management of the hives could be more readily and effectively controlled.

Preservation of Fruit.—In normal years there is usually considerable waste of fruit throughout the country. Village War Food Societies should strive to ensure that all fruit in their district is properly utilised. When in season fruit will materially aid in reducing the meat bill, and is a wholesome, health-giving food. Any fruit, however, which is not consumed fresh, or is not marketed, should be stored or preserved in some way for future use. Apples and pears may be stored in cool rooms, and soft fruits may be bottled or converted into jam, or be dried. *The Storage and Disposal of Apples and Pears* is dealt with in Special Leaflet No. 6, which shows when the fruit should be gathered, describes a useful store, and also grading for market. Members of societies might materially reduce individual costs of storing and preserving if they worked co-operatively, buying materials, etc., wholesale, bottling and preserving the members' fruit in the same way. Leaflet No. 250 (*Fruit Bottling for Small Holders*) shows clearly how bottling may be effected, and Special Leaflet No. 5 deals briefly with *Fruit Preserving for Small Market Growers or for Domestic Use.* The quantity and quality of fruit in the season 1916 might well be very much improved if the proposed societies would again work on a co-operative basis to prune, spray, and otherwise tend the fruit trees in the district, whether in orchards or small gardens. *The Pruning of Fruit Trees* is discussed and described in Leaflet No. 252, while Leaflet No. 70 deals with the *Winter Washing of Fruit Trees and Treatment of neglected Orchards. The Grading and Packing of Fruit and Vegetables* generally are dealt with in Leaflet No. 98.

Collection of Wild Fruits.—Another matter which the societies might well take in hand is the collection of wild fruits and their sale or preservation for home use. Blackberries, wild raspberries, cranberries, whortleberries, crab apples, and hazel nuts may all be collected in considerable quantity in different districts, and all add appreciably to the food resources of the collectors. The children should be induced to take up this branch of work, and the collected fruit may be sold, or bottled, or converted into jam or jelly.

Gleaning.—Co-operative "gleaning bees" for the women and children might add largely to the food of villagers, and the collected grain could be pooled and divided among the gleaners, or be valued and divided according as to whether one desired wheat, another barley, etc. Some families might quite well have the benefit of a sack or more of wheat, which could be ground for their use locally. Here again grinding might be done in one operation for all the members of the society.

Collection of Acorns, &c.—It has not been sufficiently recognised that acorns, horse chestnuts and beech mast are all useful foods for stock, especially acorns. The village societies should do all that lies in their power to utilise these products to the full. They may readily and quickly be collected by children, and even when not required for the stock owned by members, may doubtless be disposed of to neighbouring farmers. An account of the *Food Value of Acorns, Horse Chestnuts and Beech Mast*, is given in Special Leaflet No. 9.

In all rural districts are to be found spots carrying considerable amounts of rough grass and green herbage, nettles, etc. General collection of such material may result in the ownership of a useful quantity of rough hay, which may be picked over by the goat and used generally for the stock, either for food or litter. It may be possible to make it into silage with other green stuff, as described in Leaflet No. 9 (*Ensilage*).

NOTE.—Town or Urban War Food Societies might be formed on somewhat similar lines to the Village War Food Societies referred to above, but their sphere of activity would probably be largely restricted to gardening operations. Both types of societies should not only deal with increased production, but with the economic utilisation, preparation and consumption of foods in each individual home.

CO-OPERATIVE FARM IMPLEMENT SOCIETIES.

T. WIBBERLEY, N.D.A., N.D.D.,

Agricultural Expert to the Irish Agricultural Organisation Society.

THOUGH the war has caused an advance in the price of farm produce, and would therefore lead to an increase in the arable area, it should be borne in mind that it has also brought about a great shortage of manual and horse labour on the farm. As a consequence of this fact, the difficulties of the arable farmer have greatly increased.

The shortage of both kinds of farm labour could undoubtedly be overcome by the use of labour-saving implements on a more extended scale. Except on very large farms, however, the introduction of such machinery presents another difficulty; farm machinery is very costly, and average farmers of medium-sized and small farms have not sufficient capital to purchase the necessary machinery for a large extension of their tillage area.

This statement is specially true of Irish farmers, and, realising this difficulty, the writer a few years ago devised, under the auspices of the Irish Agricultural Organisation Society, a co-operative farm implement scheme, through the operations of which it has been possible to place practically every farm implement, from a one-horse plough to a high-power agricultural tractor, at the disposal of farmers who become members of the co-operative implement societies which are formed. Further, the implements have been made available to farmers by the use of a merely nominal amount of capital on the part of the individual farmer.

How far co-operation on the lines indicated is possible under English farming conditions it is for the English farmers to decide, but it will probably be of interest to them to learn what their Irish contemporaries have done in this direction, and also to get an insight into the details connected with the formation of co-operative farm implement societies.

Before giving these details, however, it will not be out of place to put before the reader a few statistics, showing how the operations of co-operative implement societies have resulted in an increase in the tillage area. In connection with these statistics it may be remarked that the co-operative farm implement scheme has only been in operation amongst

Number of Members of four Co-operative Farm Implement Societies, and the Tillage Increase amongst them for the years 1913–15.

Society.	Number of Members.	Total area in Tillage for each Society. Acres.			Average Increase per Member. Acres.
		1913.	1914.	1915.	
Meenahela, Co. Limerick	21	73	104½	158½	4·1
Killeedy, Co. Limerick	20	122	146	176	2·7
Menlough, Co. Galway	64	454½	519	683½	3·6
Fourmilehouse, Co. Roscommon	32	94	106	153	1·8
Totals	137	743½	875½	1,171	—
Averages ..	34	186	219	293	3·12

the four societies mentioned since the spring of 1913, and that these societies are by no means specially selected, except in so far as they are all situated in very poor districts, and amongst farmers whose capital is very limited, and whose holdings average about 30 statute acres.

These figures are all the more striking when it is realised that in Ireland 85 per cent. of the farms are not over 50 acres, and that at present only 12 per cent. of the available land in the country is under the plough. Had the average Irish farmer increased his cultivated area in the same ratio as the members of the societies mentioned above, during the period referred to, the result would have been an increase of over 1½ million acres under the plough.

The Formation of a Co-operative Farm Implement Society.— When it has been decided by a community of farmers to start a co-operative farm implement society, a general meeting is held by those interested in the project. At this meeting, with the help of a co-operative organiser (who always attends for the purpose) the following matters are dealt with :—

(1) The formation of a Committee, consisting of a Treasurer, a Secretary, and about nine ordinary members.

(2) The drafting of general rules for the future government of the Society.

(3) The financing of the Society.

(4) The drafting of by-laws in accordance with which the Society's implements are let out on hire.

The committee are empowered to raise the necessary capital for the financing of the society, and to transact all business appertaining to the society.

The first duty which the committee must undertake is the registration of the society in accordance with the requirements of "The Industrial and Provident Societies Act." This is necessary in order to give the society a legal standing. Registration is effected by forwarding to the Registrar appointed in connection with the Act a copy of the proposed rules of the society, stating the objects and name of the society. Application is made on a prescribed form by the members of the committee, on behalf of the society.

The legal fee for registration is £5, but if the application is sent to the Registrar *via* the Central Office of the Irish Agricultural Organisation Society the fee is reduced to £1. The cheaper rate of registration is obtainable in view of the greater ease with which the Registrar can deal with the application, after this, together with the draft rules, has been submitted to the scrutiny of the experts employed by the Central Organisation Office.

Assuming that the rules, etc., are in accordance with the requirements of the Act mentioned above, the society is duly registered and the committee are so informed. The committee are now in a position to set about raising the necessary capital to finance the society.

Capital.—The capital is invariably obtained in the form of an overdraft from the local branch of a joint stock bank. The committee act as guarantors for the amount of the overdraft, and are thus directly responsible to the bank for the security of the amount involved.

On the other hand, each shareholder in the society signs a form making himself responsible to the committee for the payment of his shares in full, in the event of the society meeting with financial disaster. The object is to make every individual shareholder financially responsible, and since the overdraft is not greater than the amount of shares allocated, the committee are guarded against any financial risks. As a rule £1 shares are issued, and each member is obliged to take at least the minimum number of shares specified by the

committee, and also pay on each share at the time of allocation whatever amount the committee decide.

As a rule each member is required to take at least five £1 shares and pay on allocation the sum of 2s. 6d. per share. The rate of interest charged by the joint stock bank to a co-operative society is very low, usually 4 per cent., and it should be understood that interest is charged only on the amount of the overdraft which the society actually has in use; that is to say, if a permissive overdraft of £500 has been obtained, and only £200 is used, interest is only charged on the latter amount.

Hiring of Implements.—The by-laws controlling the rates and terms of hire of the society's implements are framed—again with the expert assistance of an officer of the Irish Agricultural Organisation Society—to meet the specific requirements of the particular district.*

As a general rule, the implements are hired out in the order in which applications for them are made by the members, but since the main object is to encourage tillage, precedence in the use of an implement is given to the member who wishes to use the implement for the longest period. That is to say, if on the same day two men require the use of a corn binder, one having 10 acres of corn and the other 2 acres, the former takes precedence, and so on with all other implements. If in the case mentioned a second binder is not available, then the applicant with 2 acres of corn has no alternative but to harvest his crop in the ordinary manner, that is, with an ordinary manual reaper and in some of the poor districts with a scythe. Such action gives an opportunity for the display of one of the finest features of the co-operative movement, viz., the exercise of private co-operation amongst the members themselves. For example, in the case referred to the farmer who has been fortunate enough to secure the use of a corn binder, requiring at the most only one other manual helper for the harvesting of his crops, would in most cases come to the help of his fellow farmer by lending to him those of his own workers whose help is not immediately required for the saving of his own corn. It may also happen that a farmer with only a small amount of tillage may be debarred from the use of several implements, and one might be surprised that such a farmer persists in remaining a member.

* A memorandum containing suggestions for the formation of farm implement societies and the framing of by-laws may be obtained on application to the General Secretary, Agricultural Organisation Society, Queen Anne's Chambers, Tothill Street, Westminster, London, S.W.

In actual practice, however, it usually happens that the farmer who requires the use of expensive farm machinery himself possesses the cheaper implements, and thus does not require to hire such implements from his society; in consequence the cheaper implements are more at the disposal of the smaller and poorer farmers, who individually cannot afford to buy them.

Further, the greater the amount earned by the machinery the stronger the financial position of the society becomes and the sooner more implements can be purchased. As will also be readily understood, the greater the demand for any particular type of implement the more of such implements are purchased by the society.

As a general rule, the rate at which the implements are hired out to members of the society is about half of what it would cost to carry out the various operations under the old regime. If, for instance, potato sorting by hand costs 15*s.* per ton the potato sorter is hired out at 7*s.* 6*d.* per ton. If corn binding with the manual reaper costs 15*s.* per acre, then the combined reaper and binder is hired out at 7*s.* 6*d.* per acre. Again, if the ploughing of stubbles by horse labour costs 10*s.* per acre, a double disc harrowing with the agricultural tractor (which tills the land more effectively) is undertaken at the rate of 5*s.* per acre. In the case of corn threshing the usual rate is ½*d.* per stone threshed.

Implements for Nothing.—Apart from the great saving effected in the cultivation of land and the harvesting of the crops through the operations of an implement society, it is remarkable how soon a well-conducted society can earn sufficient to pay for the initial cost of the implements. Many instances are on record where a society commencing with two binders has in one harvest earned sufficient to purchase a potato digger. The potato digger has gone out on hire, and in its first season has earned sufficient to buy a corn drill, which in like manner has earned the price of a horse-power sprayer, and so on. It is usually in such a small way as the preceding that a society commences its operations. Once the farmers of a district recognise the utility of such a scheme the membership increases very rapidly. Automatically the society's borrowing powers increase, and it is then in a position to undertake the purchase of the more expensive implements, such as agricultural tractors and complementary implements, combined threshers and finishers, and mole-draining plants.

POLLINATION OF FRUIT TREES: OBSERVATIONS AND EXPERIMENTS from 1904 to 1912.

W. J. MIDDLEBROOKE.

THE theory of pollen sterility, *i.e.*, the inability of certain varieties of fruit to fertilise themselves and produce fruit, has not yet been completely established. The few experiments that have so far been carried out have not proved that any particular pollen can be said to be absolutely sterile, and they can only be regarded as a preliminary to further experiments and research. Before the theory of pollination can be made of any practical benefit to the fruit grower, many more experiments, requiring much time and patience, must be carried out in a methodical and continuous series.

The magnitude of such an undertaking must be apparent. The facilities for carrying out experiments of this nature do not exist in private gardens or even nurseries, where other work must always be the first consideration; the work can only be successfully accomplished in a properly equipped research station by a staff of experts. The problem is rendered more complex by the ever-increasing number of varieties of fruits. To make a comparison of all the varieties in cultivation, each with the rest, would be an appalling task, and any attempt to conduct experiments on such a scale would almost certainly be unsuccessful.

It is admitted that some varieties produce pollen more potent than other varieties of the same kind; it is also admitted that the mixing of varieties is beneficial in securing larger crops, and that being so, we have a very good foundation on which to build future research schemes and experiments. The first step is the collection of evidence to determine the most prolific varieties, *i.e.*, those which are likely to give the best results when used for pollination purposes; the next, to test the potency of the pollen of these varieties on shy-bearing varieties. The latter are in a minority, but, unfortunately, include some of the best flavoured and highest quality varieties, such as Ribston Pippin apple, which would become valuable to the market grower if an average crop could be secured.

It is the unsatisfactory cropping of many varieties of fruit that has led to the investigations into the relative potency of the

pollens of different varieties. Sterility cannot be attributed to close in-breeding: most of the varieties of fruit trees in cultivation originated in chance seedlings, the parentage of which is unknown, and little effort has been made to produce strains or fixed types of fruit trees as in the case of flowers and vegetables. Neither can sterility always be attributed to impotent pollen; many other agents may be responsible for the destruction of fruit crops during the flowering period.

The interest of the writer in the problem was awakened in the spring of 1906, in consequence of some failures, and partial failures, in securing satisfactory crops of fruit on some special varieties, on trees grown in pots for exhibition purposes. The failures occurred only with a few varieties, some of which were most desirable for exhibition, on account of their handsome appearance and good quality. At that time the pollination was carried out by means of hand brushes, the pollen being collected without regard to the selection of any special varieties. This system of pollination being only partially successful, further observation and experiments were made. Pollen was selected from a number of varieties of a decidedly free-bearing and free-setting nature. While doing this it was noticed that some varieties produced a much greater quantity of pollen than others. These freely pollen-producing varieties were extensively used for pollinating purposes with a conspicuous success which gave an impetus to further experiments, on a larger scale, with a larger number of varieties. The succeeding experiments were carried out in a more methodical manner, and the results were recorded for reference, with a view to the revision, if necessary, of the varieties to be used in future pollen experiments. At this stage of the experiments the system adopted for the collection of pollen was to use one brush for one variety, labelling the brush with the name of the variety from which the pollen was taken; the pollen was then applied to the varieties chosen for the application of this particular variety of pollen, the pollinated tree being labelled with the same name as the brush containing the pollen.

Pollination by Bees.—In 1910 a stock of bees was introduced into the orchard house where the trees were grown for half the season, that is through the flowering period, until the fruit was three-parts matured, when the trees were transferred to the open air to finish. The bees were introduced mainly for the purpose of pollinating currants and gooseberries, it being found impossible to do this effectually by artificial means. The bee experiment

was also a failure as far as the currants and gooseberries were concerned; the bees ignored them, and preferred to feed on the honey remaining in the hive. The bees were allowed to remain in the orchard house until the other kinds of fruit trees flowered, a portion of the trees being left unprotected for them to work upon, in order to ascertain what results bee pollination would show. The results of bee pollination were not nearly so good as those obtained by artificial pollination, but this may have been due to too many kinds of fruit being in bloom at nearly the same time. Apricots, peaches, and nectarines were the first to open flowers, and the bees worked among them well, until the cherries and plums came into flower, when they preferred the latter, and left off working the former; the same thing happened when the apples and pears came into bloom. From observations made during the experiment, it was clearly shown that the bees worked newly opened flowers for honey collection, and they did not appear to collect pollen at the same time; pollen was apparently collected separately, or by special bees. It was noticed that when alighting at the entrance to the hive some of the bees were loaded with pollen, while others had none so far as could be seen.

Very few other insects visited the flowers, and in all probability did little, if anything, towards distributing pollen. Exception must, however, be made with regard to bumble bees, a number of which were continually at work; a small dark-coloured species of bumble bee appeared very early in the season, and worked incessantly during periods of sunshine, and often on dull days when the atmosphere was warm. These small bumble bees began work earlier in the day than the hive bees and continued working later at night; they did the work of pollination very effectively. Flowers which were marked as being visited by the bumble bees were found to be effectively fertilised, the flower petals falling two days after their visit. The bumble bees did not appear to collect pollen and carry it away, but a small quantity of pollen adhered to their legs and the hirsute covering of the lower part of their bodies, thus ensuring cross-pollination.

Pollination was most effective on days with intervals of cloud and sunshine (typical of April weather) with a warm and slightly humid atmosphere. On dull, cold days and abnormally hot days pollination was ineffective. The rapid evaporation on hot, sunny days caused the foliage to flag, and the flowers to become limp, with the result that the vitality of the trees was lowered for

the time being, and the trees prevented from performing the necessary functions for effective fertilisation.

Pollination by Wind.—Experiments on pollination by wind were also tried; the wind was simulated by the use of bellows, and by shaking the trees. This method of pollination produced good results: it was also noted that out-door fruit set more freely with gentle breezes of wind and occasional showers of rain, and a sufficiently warm atmosphere.

The trees for test purposes were isolated by means of muslin screens on a framework of light canes. Suitable trees of small size were selected for the purpose, and a uniform number of fruit buds were left on each tree. As the flowers opened the anthers were removed from those to be fertilised, thus ensuring a correct test. The pollen was applied as soon as the flowers were sufficiently developed and the female organ in a receptive condition.

Value of Results Obtained.—The results of these experiments were very successful from a practical point of view, as only about 5 per cent. of the trees failed to set a sufficient quantity of fruit for a crop, and no trees were entirely barren.

The tabulated figures given below plainly indicate that there is greater possibility of securing good average crops of fruit where a number of different varieties are grown in proximity to each other.

It has been the practice of commercial fruit-growers in recent times to plant large blocks of one variety which makes a good price in the market. In doing so they have overlooked the possibility of loss of crop from ineffective pollination. In the county of Kent it is the custom to plant two rows of male hops, for the double purpose of protection from wind, and to fertilise the female or fruiting hops. Growers also plant filberts among cob nuts to assist in the work of pollination, the filberts producing a greater profusion of male catkins than cob nuts, and a better crop of nuts is ensured. Yet they have overlooked the necessity of doing the same thing with fruit trees. The policy of planting large blocks of one variety of fruit has no doubt necessitated the regrafting of a large acreage of apples and pears, the grubbing up and replanting of many acres of plums, and the discarding of many excellent and valuable varieties of all kinds of fruit.

The figures given in connection with this article cannot be regarded altogether as final, but only as a step in the right

direction of obtaining satisfactory evidence of a nature which will be of practical value to the grower. To obtain full and satisfactory information on this subject it is desirable that future experiments should be conducted in the open air under natural conditions.

From the tabulated figures given, a casual observer, unacquainted with this kind of experimental work, may think that the average results obtained show a very low percentage, but as a matter of fact the percentage was higher than was anticipated or could be expected, seeing that every flower in each truss of bloom was taken into account. No thinning was carried out, as this would have led to exaggerated results. The average number of flowers in a truss of the different kinds of fruit are roughly as follows: Apricots, 3 to 5; apples, 5 to 7; cherries, 15 to 25; nectarines and peaches, 2 to 5; pears, 9 to 12; plums, 3 to 9. Apricots, nectarines, and peaches produce a quantity of flowers singly, disposed alternately on the shoots or at intervals between triple buds, the centre bud being a growth bud. On extra vigorous shoots three to five flower buds are formed in a cluster round a growth bud. It will be seen from the number of flowers contained in a truss or bunch that it is impossible or unlikely that every flower will set and develop fruit; it was invariably found that the first flowers of a truss that opened were fertilised and began to swell immediately, while the remaining flowers of the truss, although they may have been duly pollinated, did not swell; the stalk and embryo fruit turned yellow and fell off.

The number of fruits developed on each truss vary with the variety. In apples the small and medium sized fruited varieties matured the greatest number per truss, sometimes producing as many as six fruits in one cluster; the large fruited varieties rarely retained more than one or two fruits in a bunch, although sometimes three were matured. Pears, except some of the larger fruiting varieties, which rarely matured more than three in a cluster, carried more fruit per bunch than apples. Cherries and plums are more variable than apples and pears; in favourable seasons the amount of fruit set and retained was enormous, and required considerable thinning, otherwise the fruit was small, and the trees were impoverished.

Experiments with Cider Apples.—Experiments with the pollen of cider apples were made, but not on a large scale; the results were satisfactory in the majority of the tests. Observations made in connection with orchards of cider fruit

and mixed orchards, in the county of Hereford, showed that cider varieties cropped more heavily and with greater regularity than culinary and dessert apples, and that, where culinary and dessert apples were intermixed with cider apples, better crops were obtained. One instance may be mentioned. In an orchard at Cubberley, near Ross, the following apples were growing among cider apples, viz., Blenheim Orange, Bess Pool, Ribston Pippin, Catshead, and several other varieties, all of which were heavily laden with fruit, the fruit hanging on the branches like ropes of onions, bending the branches until the tips of them touched the ground. Similar results were noted in orchards all over the county, where other varieties had been planted among cider varieties.

From observations and experiments made, it is suggested that, at any rate in grass orchards planted with standard trees, cider varieties planted among culinary and dessert apples would have a beneficial effect on the cropping of the latter. Cider varieties worked on Paradise stocks could be tried in plantations of bush trees. The varieties of cider apples experimented with were early flowering varieties; the bulk of cider apples flower late, consequently they would not be serviceable for the pollination of the majority of culinary and dessert apples.

The following varieties of early flowering cider apples were tried and are recommended; the flowering period is indicated in brackets:—Bedan des Parts (April), Cherry Hereford (middle May), De Boutteville (early May), Eggleton Styre (middle May), Handsome Hereford (middle May), Medaille d'Or (early June), Rouge Bruyere (early May), Sam's Crab (April)—(a good dessert eaten from the tree), Skyrme's Kernel (end of May), Strawberry Hereford (middle May), White Hereford (early May). All the above-mentioned varieties are extremely prolific.

Form of Fruit Tree Suitable for Pollination Experiments.—The best form of tree for pollination experiments is the single cordon, which should be grafted, or better budded, on suitable stocks. Single cordon trees occupy less room than pyramids or bush trees; they are more easily protected and isolated, and much easier to manipulate, either as pot plants or grown in the open ground. The apple should be worked on the broad-leaved English Paradise, pear or quince, and some varieties double grafted; plums on common plum and broad-leaved Mussel; cherries, Dukes and Morello on Mahaleb and other varieties on Avium; nectarines and peaches on Brompton and broad-leaved Mussel; and apricots on Brussel, Brompton, and broad-leaved

Mussel. Some varieties of stone fruit do better on one stock than another; it is therefore important that each variety should be worked on the stock best suited for it.

Experiments with grapes proved that, with the exception of Muscat Hamburgh, which showed a preference for the pollen of Black Alicante or Black Hamburgh, there was a tendency for the pollen of all varieties to set freely. The cause of bad setting in such varieties as Alnwick Seedling, Duke of Buccleuch, Mrs. Pince, Black Muscat, and White Muscat, was found to be the presence of a little drop of nectar hanging on the end of the pistil, which prevented the pollen from doing its work. The obstacle being removed there was no difficulty in securing a thickly set bunch of berries. The method adopted for the removal of the nectar obstacle was to syringe the bunches early in the day with clean warm water at a temperature of 5° F. above that of the house in which the grapes were growing; the water was driven through the bunches with some considerable force, and was projected in as fine a spray as possible; later in the day, when the bunches were dry, the hand was gently drawn down the bunches, which were afterwards shaken. Pot vines treated in this way were exhibited with as many as fifteen good-sized bunches, well packed with berries.

In the case of the currant and gooseberry tests under glass, the best results were obtained by placing the bushes in a position where they were more exposed to wind from the ventilators, and where a cooler temperature could be maintained. No difficulty was experienced with them when grown out of doors, except that they required protection from frost.

NOTE.—In the following list many varieties will appear which are not of direct interest to the commercial grower. On the other hand, most of them are grown by the professional gardener and the amateur. The tables will therefore be of interest to them, as affording a guide to possible pollinisers which they may have growing, and which, in the case of trees of more or less self-sterile varieties, it would pay them to use for artificial pollination.

*Tables showing **Results** obtained with different Fruits by Cross-Pollination as compared with the Pollination by the Varieties' own Pollen and Mixed Pollen taken from various Varieties indiscriminately.*

The names at the head of the columns indicate the varieties used for pollination. The figures given in the columns represent the percentage of fruit set and remaining on the trees at the time of thinning, the fruit being of considerable size and securely fixed. The results are from experiments carried out for five years in succession, 1907 to 1912. The trees were established in pots and fruited under glass without artificial heat.

APPLES.

Varieties.	Own Pollen.	Mixed Pollen.	Allington Pippin.	Beauty of Kent.	Belle Pontoise.	Bismarck.	Cellini.	Cox's Pomona.	Devonshire Quarrenden.	Dutch Mignonne.	Golden Spire.	James Grieve.	Jonathan.	King of Tompkins County.	Kings Acre Bountiful.	Margil.	Newton Wonder.	Scarlet Nonpareil.	The Queen.	Washington.	Wealthy.	Worcester Pearmain.
Adam's Pearmain	5	10	—	—	—	12	—	—	—	15	—	—	17	21	—	—	—	9	—	—	—	—
*Allington Pippin	15	20	—	—	—	15	—	10	—	12	—	22	—	—	—	17	—	21	—	—	—	—
American Mother	7	12	17	—	—	—	—	—	—	20	—	18	14	—	—	20	—	18	—	—	—	—
Annie Elizabeth	5	9	—	—	15	17	—	10	—	—	—	—	—	—	15	—	12	—	13	—	—	—
Astrachan Red	8	12	—	—	—	—	15	—	17	—	—	—	—	—	—	—	—	—	—	—	—	12
*Baumann's Red Winter Reinette	10	15	12	13	—	13	—	—	—	—	—	—	15	—	—	—	12	—	—	—	—	—
Beauty of Bath	3	9	—	—	—	—	17	—	16	—	—	12	—	—	—	—	—	—	—	—	—	10
*Beauty of Kent	9	12	—	—	20	22	—	19	—	—	—	—	15	—	20	—	—	—	16	—	—	—
*Belle Pontoise	12	15	—	17	—	20	—	15	—	—	—	—	—	17	—	—	21	—	22	17	—	—
Ben's Red	6	12	18	15	—	—	16	10	17	—	—	—	13	—	—	—	—	—	—	—	13	—
*Bismarck	12	16	—	19	22	—	—	17	—	—	—	—	—	25	—	—	15	—	20	—	—	—
Blenheim Orange	5	12	—	12	—	18	—	—	—	—	—	13	—	20	—	—	14	—	—	19	—	—
*Bramley's Seedling	9	17	—	—	22	—	—	—	—	—	—	—	—	15	21	—	21	—	14	—	—	—
*Cellini	12	22	—	14	—	25	—	15	—	—	—	—	—	—	18	—	—	—	15	—	—	—
Charles Ross	3	12	—	—	16	—	10	12	—	—	—	7	—	15	—	—	13	—	—	—	9	—
*Christmas Pearmain ..	10	14	15	—	—	—	—	—	—	20	—	—	—	—	—	15	—	23	—	21	—	—
Cornish Aromatic	6	13	—	—	—	—	—	—	—	19	—	—	17	—	—	10	—	16	—	—	—	—

* Denotes free pollen bearers.

APPLES—*continued.*

VARIETIES.	Own Pollen.	Mixed Pollen.	Allington Pippin.	Beauty of Kent.	Belle Pontoise.	Bismarck.	Cellini.	Cox's Pomona.	Devonshire Quarrenden.	Dutch Mignonne.	Golden Spire.	James Grieve.	Jonathan.	King of Tompkins County.	Kings Acre Bountiful.	Margil.	Newton Wonder.	Scarlet Nonpareil.	The Queen.	Washington.	Wealthy.	Worcester Pearmain.
Cornish Gilliflower	3	10	9	—	—	—	—	—	—	—	—	—	12	—	—	7	—	12	—	—	—	—
Coronation	7	12	—	18	—	17	—	15	—	—	—	—	7	—	—	—	—	—	—	12	—	—
*Court Pendu Plat	15	15	—	—	—	—	—	—	—	25	—	—	17	—	—	—	—	21	—	—	16	—
*Cox's Orange Pippin.. ..	9	15	22	15	—	17	—	12	10	20	—	20	19	16	—	15	—	25	—	17	15	15
*Cox's Pomona	10	17	—	12	—	19	—	—	—	—	—	—	—	15	—	—	—	—	20	13	—	—
*Crimson Queening	7	12	—	—	—	—	—	—	—	—	—	15	—	—	—	—	—	—	—	17	10	13
*Devonshire Quarrenden ..	12	15	—	—	—	—	—	—	—	—	—	17	—	—	—	—	—	—	—	—	—	20
*Duchess of Gloucester ..	10	17	15	—	—	—	—	—	19	—	—	13	—	—	—	—	—	—	—	—	—	18
*Duchess of Oldenburgh ..	9	15	—	—	—	15	19	—	—	—	17	—	—	—	23	—	—	—	16	—	—	17
*Dutch Mignonne	12	14	—	17	—	18	—	—	—	—	—	—	21	—	—	15	—	20	—	—	—	—
Ecklinville Seedling ..	3	10	—	—	—	—	12	—	—	—	19	—	—	—	22	—	—	—	15	—	—	—
Egremont Russet	7	12	22	—	—	—	—	—	—	15	—	—	18	—	—	14	—	21	—	—	—	—
Emperor Alexander ..	6	12	—	18	18	21	—	17	—	—	—	—	—	20	—	—	—	—	19	23	16	—
*Frogmore Prolific	15	20	—	—	—	—	—	—	—	—	21	—	—	—	25	—	—	—	18	—	—	—
Gascoigne's Scarlet Seedling	9	14	—	17	—	20	—	17	—	—	—	—	19	—	—	—	17	—	—	—	20	—
Gloria Mundi	4	12	—	—	15	—	—	13	—	—	—	—	—	12	—	—	15	—	14	—	—	—
*Golden Spire	13	17	—	—	—	—	20	—	—	—	—	15	—	—	25	—	—	—	—	—	—	—
*Grenadier	12	18	—	—	—	16	15	—	—	—	—	—	—	—	19	—	—	—	8	—	—	—
*Hambling's Seedling ..	2	7	—	—	—	12	9	7	—	—	—	—	—	—	—	—	12	—	—	—	—	—
Hawthornden..	5	12	—	—	10	7	—	15	—	—	—	—	—	—	13	—	9	—	—	—	—	—
Hollandbury	7	12	—	10	—	—	—	12	—	—	—	—	—	—	—	—	15	—	17	—	—	—
Irish Peach	10	13	—	—	—	—	—	—	17	—	—	—	—	—	—	—	—	—	—	—	—	12
*James Grieve	12	15	17	—	—	13	—	—	18	—	10	—	—	—	16	—	—	19	—	21	—	19
*Jonathan	10	17	12	—	—	14	—	—	—	20	—	17	15	17	—	—	—	15	—	19	—	—
*King of the Pippins	9	17	20	—	—	—	—	—	—	—	—	—	15	—	—	—	—	19	—	—	16	—
*King of Tompkins County ..	7	12	—	10	—	17	—	7	—	—	—	—	—	—	—	—	18	—	—	20	13	—
*Kings Acre Bountiful ..	17	21	—	—	—	—	15	12	—	—	20	—	—	—	—	—	—	—	17	—	—	—

*Kings Acre Pippin	9	15	—	—	—	—	—	—	—	19	—	—	21	—	—	—	—	12	—	17	—	—
Lady Sudeley	7	13	—	—	—	—	—	—	17	—	—	20	—	—	—	—	—	—	—	15	—	15
*Lane's Prince Albert ..	10	15	—	—	17	15	—	—	—	—	—	—	—	—	19	—	16	—	9	—	—	—
Langley Pippin	5	12	—	—	—	—	—	—	15	—	—	7	—	—	—	—	—	—	—	—	—	13
Lawreys Cornish Giant ..	8	12	—	9	—	12	—	12	—	—	—	—	—	15	—	—	18	—	—	—	—	—
*Lord Derby	10	17	—	—	15	—	12	—	—	—	17	—	—	—	21	—	—	—	19	—	—	—
*Lord Hindlip	9	15	12	—	—	—	—	—	—	17	—	—	19	—	—	—	—	21	—	—	15	—
*Margil	12	20	17	—	—	—	—	—	—	19	—	21	—	—	—	—	—	19	—	—	15	—
Mere de Menage	5	12	—	15	18	17	—	12	—	—	—	—	—	13	—	—	10	—	—	—	—	—
*Mr. Gladstone	10	18	—	—	—	—	—	—	17	—	—	20	—	—	—	—	—	—	—	—	—	16
*Newton Wonder	15	20	—	12	—	19	—	10	—	—	—	—	—	17	—	—	—	—	20	—	18	—
*Norfolk Beauty	9	13	—	—	—	12	—	—	—	—	—	—	—	—	15	—	13	—	12	—	—	—
*Peasgood's Nonsuch ..	10	17	—	13	—	12	—	10	—	—	—	15	—	—	—	—	16	—	15	—	—	—
*Pott's Seedling	12	15	—	—	—	—	12	—	—	—	16	—	—	—	19	—	—	—	—	—	—	—
Reinette du Canada	7	12	—	—	—	—	—	—	—	15	—	—	—	—	—	—	—	—	—	14	—	—
Ribston Pippin	3	9	—	—	—	—	—	—	—	17	—	—	—	—	—	15	—	—	—	17	—	—
*Rival	9	15	12	—	—	—	—	—	—	—	—	—	15	—	—	—	—	—	—	—	—	—
Rosemary Russet	6	9	—	—	—	—	—	—	—	12	—	—	—	—	—	—	—	15	—	—	—	—
*Royal Jubilee	12	17	—	—	15	—	—	—	—	—	—	—	—	—	—	—	—	—	19	—	—	—
*Sandringham	10	17	—	—	15	—	—	—	—	—	—	—	—	12	—	—	19	—	17	—	—	—
*Scarlet Nonpareil	17	25	—	—	—	—	—	—	—	19	—	—	17	—	—	—	—	—	—	—	15	—
*St. Edmund's Pippin ..	13	15	—	—	—	—	—	—	—	12	—	—	—	—	—	16	—	19	—	—	12	—
*Stirling Castle	20	21	—	—	—	20	—	—	—	—	—	—	—	—	19	—	—	—	15	—	—	—
*Sturmer Pippin	10	18	—	—	—	—	—	—	—	22	—	—	15	—	—	—	—	17	—	—	—	—
*The Queen	12	15	—	—	—	23	—	15	—	—	—	—	—	17	—	—	12	—	—	15	12	—
Twenty Ounce	9	13	—	15	—	12	—	—	—	—	—	—	—	13	—	—	—	—	17	—	—	—
*Tyler's Kernel	12	17	—	—	—	—	—	15	—	—	—	—	—	—	—	—	—	—	12	15	—	—
Warner's King	9	16	—	—	—	15	—	—	—	—	—	—	—	—	17	—	—	—	13	—	—	—
*Washington	7	15	—	—	—	17	—	—	—	—	—	—	14	17	—	—	—	—	—	—	12	13
*Wealthy	12	18	—	—	—	20	—	10	—	—	—	—	17	—	—	—	—	—	15	12	—	15
White Transparent	5	12	—	—	—	—	—	—	15	—	15	20	—	—	—	—	—	—	—	—	—	—
*William Crump	10	12	15	—	—	—	—	—	—	—	—	17	—	—	—	—	—	—	—	—	—	18
*William's Favourite	12	15	—	—	—	—	—	—	17	—	—	—	—	—	—	—	—	—	—	—	—	15
*Worcester Pearmain ..	17	17	15	—	—	—	—	—	20	—	—	19	—	—	—	—	—	—	—	17	—	—
Yorkshire Beauty (syn. Red Hawthornden)	7	12	—	15	—	—	15	—	—	—	—	—	—	12	—	—	9	—	—	—	—	—
Average percentage ..	9·2	14·54	15·62	14·30	16·76	16·48	14·38	12·76	16·53	17·66	16·87	16·21	16·00	16·26	19·23	14·40	14·62	15·00	15·81	16·89	14·19	15·06

* Denotes free pollen bearers.

PEARS.

VARIETIES.	Own Pollen.	Mixed Pollen.	Bergamotte Esperen.	Beurré Clairgeau.	Beurré Hardy.	Beurré Rance.	Beurré Superfin.	Bon Chretien (Williams).	Conference.	Dr. Jules Guyot.	Emile d' Heyst.	Louise Bonne of Jersey.	Marie Louise d'Uccle.	Nouveau Poiteau.	President d'Osmonville.	Princess.	St. Luke.	Triomphe de Vienne.	Vicar of Winkfield.	Klondike (not in commerce).	Charles Ernest.
*Bergamotte Esperen	5	15	—	—	—	—	—	—	17	—	13	20	—	—	—	17	—	—	—	—	—
*Beurré d'Amanlis	7	20	—	—	—	—	—	15	—	17	—	—	—	—	—	—	—	22	—	24	—
Beurré Bachelier	5	17	15	—	—	—	—	—	—	—	—	—	16	20	—	—	—	—	12	—	—
Beurré Baltet Pere	9	18	—	—	—	20	—	—	—	—	15	—	—	17	—	—	—	—	—	—	13
Beurré Bosc..	3	12	—	—	15	—	17	—	—	—	—	—	15	—	—	10	—	—	—	12	—
*Beurré Clairgeau	12	19	—	—	—	—	—	—	20	—	17	—	—	15	—	—	—	—	16	—	—
*Beurré Diel	7	17	—	—	15	—	13	—	—	—	—	—	—	—	—	—	17	—	—	—	—
Beurré Dubuisson	5	13	—	—	—	12	—	—	—	—	—	—	15	—	17	—	—	—	—	—	20
Beurré Foqueray	12	17	—	—	20	—	—	—	15	—	—	17	—	—	—	15	—	—	—	—	—
*Beurré Hardy	12	22	17	—	—	—	20	—	17	—	—	—	—	—	—	—	—	—	—	—	25
*Beurré Mortillet	9	17	—	19	—	—	—	—	15	21	—	—	—	—	—	—	—	24	—	—	—
*Beurré Rance	15	21	18	—	—	—	—	—	—	—	—	—	—	—	23	—	—	—	—	—	21
*Beurré Superfin	12	15	—	—	17	—	—	—	19	—	—	16	—	—	—	—	20	—	—	—	—
*Bon Chretien (Williams)	12	18	—	—	—	—	—	—	—	23	—	—	—	—	—	—	20	—	—	17	—
*Charles Ernest	9	20	15	—	—	18	—	—	—	—	—	—	—	20	25	—	—	—	—	—	—
Chaumontel	5	12	—	—	—	15	—	—	—	—	—	—	17	19	—	—	—	—	—	—	15
Clapp's Favourite	3	15	—	—	16	—	—	15	—	—	—	19	—	—	—	—	—	21	—	—	—
*Conference	15	23	—	—	17	—	—	—	—	—	—	20	—	—	—	19	—	17	—	—	—
*Doyenné Boussoch	12	18	13	—	—	17	—	—	—	—	—	—	—	—	21	—	—	—	—	19	—
Doyenné du Comice	5	15	—	—	—	—	19	—	—	—	20	17	—	—	—	—	—	—	—	21	—
*Dr. Jules Guyot	15	22	—	—	—	—	—	17	—	—	—	19	—	—	—	—	—	23	—	15	—
Duchess d'Angouléme	7	10	—	—	—	—	15	—	17	—	—	—	—	—	12	—	—	—	—	—	—
*Durondeau	7	15	—	—	20	—	—	—	—	—	16	—	17	—	—	15	—	—	—	—	—

*Émile d'Heyst	15	25	17	—	13	—	18	—	—	—	—	—	20	—	—	—	—	—	—	—	—	—	—	—
General Todleben	5	12	—	17	—	—	—	—	—	—	—	—	—	—	20	20	—	—	—	—	18	—	—	—
*Glou Morceau	5	15	12	—	—	17	—	—	—	—	—	—	—	—	—	23	—	—	—	—	—	—	—	17
*Gratioli of Jersey	15	20	—	—	19	—	—	—	21	20	—	—	—	—	—	—	—	—	20	—	—	—	—	—
*Josephine de Malines	12	22	20	—	—	15	—	—	—	—	—	—	—	—	17	17	—	—	—	—	—	—	—	19
Le Lectier	3	12	—	—	—	13	—	—	—	—	—	—	—	—	12	15	—	—	—	—	—	—	—	—
*Louise Bonne of Jersey	15	21	—	—	—	—	—	—	19	—	17	—	—	—	—	—	23	—	—	—	—	20	—	—
*Madame Treyve	12	15	—	—	17	—	—	20	—	15	—	—	—	—	—	—	—	—	19	—	—	—	—	—
Magnate	2	9	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Marguerite Marillat	5	12	—	—	—	—	—	—	15	—	—	—	12	13	—	—	12	—	—	—	—	—	—	13
Marie Benoist	7	12	10	—	—	15	—	—	—	—	—	—	—	—	—	17	—	—	—	—	—	—	—	17
Marie Louise	3	12	—	—	—	—	—	—	—	—	—	—	15	17	—	—	—	—	—	—	13	—	—	—
*Marie Louise d'Uccle	9	17	—	—	15	—	—	—	18	—	—	—	20	—	—	—	—	—	—	—	—	17	—	—
*Nouveau Poiteau	9	19	15	—	—	20	—	—	—	—	—	—	—	—	—	19	—	—	—	—	13	—	—	10
Nouvelle Fulvie	7	15	20	—	—	12	—	—	—	—	—	—	—	—	17	—	—	—	—	—	—	—	—	15
Olivier de Serres	12	20	20	—	—	15	—	—	—	—	—	—	—	—	—	17	—	—	—	—	—	17	—	—
Pitmaston Duchess	5	12	—	—	—	—	—	—	15	—	—	—	—	—	—	13	—	—	—	—	—	—	—	20
*President d'Osmonville	15	21	15	—	—	18	—	—	—	—	—	—	—	12	17	—	—	—	—	—	—	—	—	—
*Princess	15	25	—	—	—	—	—	—	20	17	—	—	21	—	—	—	—	—	17	—	—	—	—	—
St. Luke	9	17	—	—	17	—	—	12	—	—	—	—	—	—	—	—	—	—	—	—	—	15	—	—
*Souvenir du Congres	7	15	—	—	—	—	—	—	19	—	15	—	—	—	—	12	—	—	—	—	—	—	—	—
*Triomphe de Vienne	12	18	—	—	20	—	—	21	—	25	—	—	—	—	—	—	—	—	—	—	—	—	—	—
*Uvedale's St. Germain	5	12	—	—	—	15	—	—	—	—	—	—	—	—	—	13	—	—	—	—	—	—	—	17
*Vicar of Winkfield	7	13	—	15	—	—	—	—	17	—	—	—	—	12	—	—	—	—	—	—	—	10	—	—
*Klondike (not in commerce) ..	17	20	—	—	—	—	—	—	—	—	—	—	—	—	—	15	—	—	21	—	—	—	—	—
Average percentage ..	8·97	16·70	15·92	17·0	17·0	15.85	17·0	16·66	17·60	19·71	16·14	18·0	14·88	17·40	17·43	15·85	19·0	20·44	14·40	17·00	17·07			

* Denotes free pollen bearers.

APRICOTS.

VARIETIES.	Own Pollen.	Mixed Pollen.	Kaisha.	Moor-park.	Oullins Early.
Hemskirk	15	20	28	25	30
*Kaisha	18	25	—	32	38
*Moorpark	20	35	30	—	42
New Large Early	17	25	23	25	25
*Oullins Early	18	27	40	35	—
Shipley	19	23	33	27	32
*St. Ambroise	13	26	25	20	27
Average percentage ..	17·14	25·85	29·83	27·33	32·33

* Denotes free pollen bearers.

NECTARINES.

VARIETIES.	Own Pollen.	Mixed Pollen	Car-dinal.	Dry-den.	Gold-oni.	Pine Apple.	Spen-ser.
Byron	7	12	—	17	—	—	—
*Cardinal	15	25	—	30	—	—	—
*Dryden	20	25	20	—	23	—	—
*Early Rivers	12	17	22	25	—	—	—
Elruge	12	15	—	20	17	—	18
*Goldoni	20	16	15	—	—	—	—
Humboldt	12	15	—	—	—	25	20
*Lord Napier	12	17	19	22	—	20	—
Newton	5	12	—	15	—	—	—
*Pine Apple	23	20	—	30	22	—	17
*River's Early Orange ..	17	25	15	—	27	20	—
*Spenser	12	18	—	—	20	25	—
Violette Hative ..	9	15	—	17	—	12	20
Average percentage ..	13·53	17·84	18·20	22·0	21·80	20·40	18·75

* Denotes free pollen bearers.

CHERRIES.

VARIETIES.	Own Pollen.	Mixed Pollen.	Frogmore Early Bigarreau.	Governor Wood.	Knight's Early Black.	Late Duke.	Morello.	Werder's Early Black.	Gean or Wild Cherry.
*Bigarreau de Schrecken ..	19	30	35	—	—	—	25	28	—
Bigarreau Napoleon	17	27	—	35	—	—	20	—	30
Black Tartarian	7	25	—	—	30	—	—	20	17
*Early Rivers	15	32	45	—	25	—	—	35	28
Elton	12	20	—	30	—	25	27	—	—
*Frogmore Early Bigarreau ..	28	45	—	—	40	—	—	30	—
*Governor Wood	19	25	27	—	—	—	20	—	30
*Knight's Early Black ..	23	38	30	—	—	—	—	25	28
*Late Duke	17	30	—	—	—	—	45	—	40
*May Duke	5	20	35	—	28	25	30	—	19
*Morello	45	40	—	—	—	30	—	—	42
Noble	9	25	20	28	—	—	17	—	15
Waterloo	12	28	15	—	25	—	20	—	20
*Werder's Early Black ..	25	42	—	—	30	—	—	—	25
Average percentage ..	18·07	30·50	29·57	31·00	29·66	26·66	25·50	27·60	26·72

* Denotes free pollen bearers.

PEACHES.

Varieties.	Own Pollen.	Mixed Pollen.	Condor.	Crimson Galande.	Dr. Hogg.	Duke of York.	Dymond.	Early Grosse Mignonne.	Golden Eagle.	Late Devonian.	Peregrine.	Royal George.	Sea Eagle.	Thomas Rivers.
Alexandra Noblesse	9	15	—	21	20	—	—	—	25	—	23	17	—	—
Barrington	12	20	—	—	—	—	—	—	22	20	30	—	23	25
*Bellegarde	17	18	—	—	—	—	20	—	—	—	25	23	—	—
*Condor	15	20	—	25	23	30	—	21	—	—	—	—	—	—
*Crimson Galande	20	20	—	—	22	—	—	24	—	—	28	25	—	—
*Dr. Hogg	25	27	—	—	—	23	—	27	—	—	22	—	—	—
*Duchess of Cornwall	20	21	18	—	21	25	—	—	—	—	—	—	—	—
*Duke of York	20	25	—	—	20	—	—	17	—	—	27	21	—	—
*Dymond	17	21	—	23	—	—	—	—	—	—	21	27	—	—
Early Alexander	9	22	17	—	22	27	—	19	—	—	—	—	—	—
*Early Grosse Mignonne	15	17	—	27	23	20	—	—	—	—	—	—	—	—
Early Louise	12	15	20	—	—	17	—	15	—	—	—	—	—	—
Early Silver	10	12	17	—	21	23	—	18	—	—	—	—	—	—
Exquisite	10	20	—	25	—	—	17	—	—	—	19	20	—	—
*Golden Eagle	25	21	—	—	—	—	—	—	—	22	—	—	23	30
Goshawk	17	16	—	23	—	—	25	—	—	—	30	—	—	—
Grosse Mignonne	12	15	—	17	—	—	20	—	—	—	21	19	—	—
Hale's Early	7	10	17	—	23	27	—	—	—	—	—	—	—	—
Late Admirable	7	13	—	—	—	—	—	—	20	—	—	—	21	23
*Late Devonian	15	20	—	—	—	—	—	—	25	—	—	—	20	20
Nectarine Peach	15	17	—	—	—	—	20	—	22	19	—	—	21	20
Noblesse	12	20	—	25	—	—	18	—	—	—	22	20	—	—
*Peregrine	25	20	—	23	—	—	21	—	—	—	—	21	—	—
Princess of Wales	12	19	—	—	—	—	—	—	23	—	—	—	19	23
*Royal George	20	21	—	20	—	—	23	—	—	—	23	—	—	—
Rivers' Early York	15	20	17	—	25	21	—	20	—	—	—	—	—	—
*Sea Eagle	20	23	—	—	—	—	—	—	21	20	—	—	—	25
*Thomas Rivers	25	20	—	—	—	—	—	—	20	19	—	—	22	—
*Violette Hâtive	17	25	—	22	—	—	24	—	—	—	20	25	—	—
Walburton Admirable	9	15	—	—	—	—	—	—	20	17	—	—	20	19
Waterloo	12	13	20	—	17	21	—	—	—	—	—	—	—	—
Average percentage ..	15·35	18·74	18·0	22·81	21·54	23·40	20·88	20·12	22·0	19·50	23·92	21·80	21·12	23·12

* Denotes free pollen bearers.

PLUMS.

VARIETIES.	Own Pollen.	Mixed Pollen.	Blue Rock.	Count Althan's Gage.	Denniston's Superb.	Early Prolific.	Grand Duke.	Heron.	Jefferson.	Late Orange.	Mallard.	Monarch.	Oullins Golden Gage.	Pond's Seedling.	Prince of Wales.	Swan.	Curlew.	Cox's Emperor.	Coe's Golden Drop.
Admiral..	12	15	17	—	—	—	15	—	—	—	—	17	—	—	—	—	15	—	—
*Angelina Burdett	15	17	—	15	20	—	—	—	—	—	17	—	—	—	15	—	—	—	—
Belle de Louvain	12	17	—	—	—	—	—	15	—	—	—	—	10	—	—	20	—	13	—
*Belle de Septembre	10	15	—	12	—	—	17	—	—	—	—	—	—	19	—	—	—	—	—
*Blue Rock	25	21	—	—	17	15	—	20	—	—	15	—	—	—	—	17	—	—	—
Bryanston Gage	3	12	—	—	20	—	—	—	17	12	—	—	15	—	—	—	—	—	10
*Coe's Golden Drop	10	17	—	—	15	—	17	—	15	20	—	—	15	—	—	—	—	—	—
*Count Althan's Gage	12	20	23	—	—	—	—	17	—	—	17	—	—	15	—	—	—	17	—
*Cox's Emperor	12	16	—	—	—	—	12	—	15	—	15	—	—	—	20	—	15	—	—
*Curlew	15	22	24	15	—	—	—	20	—	—	—	15	—	—	—	25	—	—	—
*Czar, The	15	25	23	—	—	17	—	19	—	—	17	—	—	—	—	—	21	—	—
*Denniston's Superb	25	27	21	—	—	—	—	—	20	—	—	—	17	—	—	—	—	—	19
Diamond	9	15	—	—	—	—	21	—	—	—	—	17	—	—	—	23	18	—	—
Early Prolific	5	12	17	—	15	—	—	13	—	—	—	—	—	—	—	—	12	—	—
Early Transparent Gage	5	12	—	—	17	—	—	—	20	15	—	—	18	—	—	—	—	—	15
Golden Esperin	3	7	—	—	12	—	—	—	14	—	—	—	10	—	—	—	—	—	12
Golden Transparent Gage	3	7	—	—	9	—	—	—	10	—	—	—	12	—	—	—	—	—	10
*Grand Duke	12	17	—	15	—	—	—	—	—	—	15	20	—	—	—	18	—	—	—
Green Gage	3	10	—	—	12	—	—	—	10	15	—	—	12	—	—	—	—	—	10
*Heron	15	19	20	17	—	—	—	—	—	—	15	—	—	12	—	—	15	—	—
*Jefferson	12	20	—	15	25	—	—	—	—	19	—	—	23	—	—	—	—	—	17
July Green Gage	12	17	—	—	20	—	—	—	15	—	—	—	17	—	—	—	—	—	12
Kirk's	10	15	—	17	—	—	17	—	—	—	—	20	—	—	12	—	—	—	—

*Late Orange	17	23	—	—	20	—	15	—	17	—	—	17	—	20	—	—	—	—	20
Late Transparent Gage	1	7	—	—	5	—	—	—	3	7	—	—	—	—	—	—	—	—	5
*Magnum Bonum, White	12	19	—	—	15	—	—	—	13	17	—	—	12	15	—	—	—	—	16
*Mallard	17	21	18	15	—	—	—	—	—	—	—	20	—	17	—	20	—	—	—
McLaughlin's Gage	5	12	—	—	17	—	—	15	12	—	—	—	15	—	—	—	—	—	—
*Monarch	15	23	—	19	—	—	20	—	—	—	17	—	—	12	—	13	—	—	—
Orleans, New	13	17	15	17	—	—	—	20	—	—	15	—	—	—	13	—	—	17	—
*Oullins Golden Gage	15	20	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
*Pond's Seedling	15	20	—	19	—	—	13	—	19	—	13	—	—	—	—	—	—	15	—
President	7	10	—	12	—	—	15	—	—	—	—	12	—	—	—	—	—	—	—
Primate	3	7	—	7	—	—	5	—	—	10	—	—	—	—	—	—	—	—	—
*Prince of Wales	12	17	15	—	—	—	—	15	—	—	19	13	—	—	—	—	—	—	—
Reine Claude de Bavay	7	15	—	—	15	—	—	—	12	—	—	—	10	—	—	—	—	—	—
*Sultan	15	19	17	—	—	10	—	20	—	—	17	—	—	—	—	—	15	—	—
*Swan	27	25	15	—	—	—	—	19	—	—	23	—	—	—	—	—	20	—	—
Transparent Gage	3	10	—	—	10	—	—	—	7	9	—	—	10	—	—	—	—	—	10
*Washington	5	13	—	—	15	—	—	—	12	12	—	—	—	—	—	—	—	—	15
Average percentage ..	11·10	16·32	18·75	15·0	15·5	14·0	15·2	17·54	13·53	13·60	16·53	16·77	14·0	15·71	15·0	19·43	16·37	15·5	13·15

* Denotes free pollen bearers.

KARAKUL SHEEP.

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THE Karakul sheep are the best fur-producing breeds of the lofty plateaux of Central Asia. Their home is in the arid region in Western Russian Turkestan comprising the Kizil-Kum and Kara-Kum deserts and the Khanates of Bokhara and Khiva. The district is situated east of the Caspian Sea and north of Afghanistan. Northern Afghanistan also has a few Karakul sheep, and a few are raised in Persia. The name Karakul (meaning "black lake") refers to the lake in the town of the same name on the lower Zarafshan in Bokhara, which is an important centre of the lamb-fur and sheep-skin

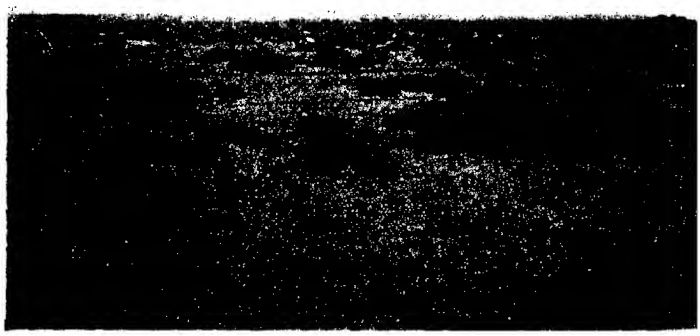

FIG. 1.—Kara-Kum Desert showing the Bushes of Sacksaul on which Karakul Sheep and Camels feed.

industry. The Kara-Kum Desert (Fig. 1) is extremely barren, consisting of sand dunes and saline steppes covered with thorny scrub, and, where there is no drifting sand and the soil is clayey in nature, a little grass in spring. During the summer it is very hot and there is little rain, while in winter the temperature falls below zero. Under such trying climatic extremes it is little wonder that the Karakul sheep have earned the reputation of being perhaps the hardiest of all domesticated animals.

Origin of the Breed.—There is no subject in which there is more confusion with regard to facts in general, including classification, than that of Asiatic sheep. Towards this state

of uncertainty there are several contributory causes. Military considerations forbid exploration in Afghanistan and in important regions of Bokhara under Russian domination. Moreover, neither the ancient nor the modern authorities have properly differentiated between the two great branches of the ovine race which supply the preponderating numbers of the vast hordes of sheep of Western Asia—the fat-rump or "Kurdiuk" type (*Ovis steatopyga*), and the broad-tail type (*Ovis platyura*). The Karakul breeds are correctly classified as a type of the true *Ovis platyura*, having sprung from a cross of the black, long-tail Danadar, now practically extinct on the fat-rump varieties known as Chulmi and Achuri.*

FIG. 2.—Types of Karakul and other Asiatic Sheep.

Left to right:—(1) Shorn red Kalmuck fat-rump ram; (2) Shorn Karakul ram; (3) Unshorn 4-horned Karachaev ram; (4) Karakul-Afghan Fine-wool ewe (of no value as a fur producer), and, behind, a Karakul Coarse-wool ram; (5) Karakul lamb, 3 months old, the curls having opened and the fur value being lost.

Karakul sheep are invariably classed under three orders, Arabi, Duzbai and Shiraz. (1) The first order seems to indicate that this breed was first introduced from Arabia, although neither history nor the Arabian sheep of to-day support the assumption. (2) The Karakul sheep of the Duzbai order, which, like all Asiatic sheep, is not an absolutely pure breed, has produced the best fur since the disappearance of the historical Small Arabi.† (3) In Bokhara and across the

* Various American breeders, including Dr. C. C. Young, have produced broad-tailed sheep by crossing long-tails on fat-rumps.

† Dr. Young states that this was practically the original black Danadar.

mountains in Persia one finds the "Shiraz" or half Persian sheep, named from the town of Shiraz. Any grey lamb is now called a Shiraz. Their quality depends on whether a good or a bad Karakul ram had been got from Bokhara and whether he had been bred to coarse-wool, fat-rump or soft-wool Afghan ewes. Figs. 2 to 5 show types of Karakul and other Asiatic breeds of sheep.

Characteristics.—The Karakul-Duzbai is a large sheep, altogether black at birth, with the possible occasional exception of a white spot on the forehead or a white tip to the tail. As a rule the ewe is hornless, and the ram generally, though not invariably, carries horns of moderate dimensions which fall short of making a spiral turn. The head is long, somewhat narrow, with a high, arching nose descending abruptly to the muzzle and giving it something of a tapering appearance, partly the result of the shape of the nostrils, the lips of which are folded in and contracted rather than expanded, evidently as a natural protection against driving sand. The ears are of medium length and pendant, as is the rule with the ears of most domestic animals of the tropical East. The bone is strong and clean, the legs tight and well formed and the feet large. The movement in walking or running is free and active, and the carriage gay. The withers are high and sharp, the loins broad and the hind quarters low, short and markedly drooping. The characteristic tail "tapers into a noticeably twisted end," the broad, flat, fatty base sometimes weighing as much as 15 to 20 lb. in full-grown rams. The store of nutriment in the tail is akin to the reserve provided by the hump of the camel and of the zebu race of cattle, and, being drawn upon for sustenance in cases of emergency, it enables an animal deprived of food and water—no unusual occurrence in the desert—to subsist for many days. The characteristics of a Karakul-Duzbai may be seen in Figs. 7 and 8 (pages 440 and 441).

When the Karakul-Duzbai is crossed with European sheep there is a wonderful increase in weight, owing to the preponderance of the fat-tail blood. Karakul mutton is of excellent gamey quality, free from the sheepy flavour that is specially characteristic of a full-grown Cotswold, and, to a less degree, of many other essentially fleshy longwool British breeds. The manager of the Armour Packing Company, of Fortworth, Texas, has written of Karakul crosses with other domestic breeds of sheep: "Lambs are obtained which at the proper lamb age weigh 90 to 105 lb. and have a most delicious flavour, as well as a heavy yield of mutton."

FIG. 3.—Afghan Fine-wool Sheep in the Afghan Border Region.

FIG. 4.—*Left*: Shiraz Ram; *Right*: Duzbai Ram.
Both purchased near Kara-Kum, Bokhara, and sent to Prince Edward Island.

Karakul ewes sometimes breed twice in the year, but, except when placed under exceptionally favourable circumstances, this is a severe strain on any breed of sheep, and is not general. Some produce twins and triplets. The lamb has for about three days a close lustrous fur (Fig. 12), which afterwards becomes loose and open and grows rapidly in length. At about the third month, as a rule, a fleece, still quite black, of straight wool has developed in the ram, but it begins to turn grey about the sixth month. The hair-like wool becomes long and strong, although it still retains much of its lustre. The similar wool of ewes, when of highest quality, retains for a longer period a remnant of the early curly condition in loose and open locks. It is important to note that for fur-producing purposes the Karakul-Duzbai ram alone produces a useful cross, and that lambs resulting from crossing a Karakul ewe and a ram of another breed are inferior.

Production of Fur.—The most essential feature of the wool of the Karakul sheep as it ought to be is the complete absence of the undercoat of fine, downy wool belonging the Afghan fine-wool sheep. The jet-black, tight-curling, lustrous fur of the newly-born lambs is the most important characteristic of the breed, and, with one exception, is the most valuable commercial product. This fur is misleadingly called "Persian Lamb" in the trade, and though two explanations are put forward, it is not definitely known how the mistake arose. The correct name, from a geographical point of view, would be "Bokharans," as none of the lamb-skins came from Persia until about twelve or fifteen years ago, when a few of very inferior quality appeared.

The value of the "Persian Lamb" skin depends (1) on the form and tightness of the long, pipe-shaped curl, the points of the closely-knit locks in the finest specimens being turned in so that few ends appear on the surface; (2) on the beauty of the pattern formed by the irregular yet artistic arrangement which, along each side of the back line, often takes the form of delightful natural unrestrained bars, and (3) on the thinness or fineness and softness of the hair or wool, together with its great brilliancy. Fig. 12 shows an exceptionally fine "Persian Lamb" fur, while Karakul and cross-bred lambs possessing skins of various qualities may be seen in Figs. 6, 9, 10 and 11.

"Persian Lamb" skins have a length of about 20 in., and come to the market in an air-dried, raw condition, the value of first-grade skins being about £1 10s. each, imperfectly curled skins being very much less, down to a few shillings or

even pence. The best skins are produced by lambs killed within 75 to 80 hours after birth; the small size then to some extent counterbalances the money value of the superior quality and tightness of the curl.

Although the skins can easily be separated into a few lots according to their market value, the individual variation is so great that out of hundreds, or even thousands, it is practically impossible to find two skins that exactly match. There are broadly three divisions according to the size of the curl—small, intermediate and large. In Russia the intermediate curl is most prized, other factors being equal. Considerable variation in the size of the curl appears in different offspring from the same parents, and by some this has been attributed to feeding, though, like the colour and quality of the hair of some of our domestic animals in this country, it is probably due to natural constitutional variation.

The low average price of a large quantity of skins shows that an enormous number of inferior sheep are kept which ought to be capable of improvement by scientific breeding. In 1905 one Leipzig house bought in Bokhara 385,000 skins at 16s. each. Dr. C. C. Young, of Belen, Texas, who is an authority on Karakul sheep, and who has several times visited Bokhara, asserts that the quality has declined 85 per cent. in 10 years.

The so-called "Broadtail" fur, which presents a fine, short, straight, figured, velvet-like hair of glossy black and great lustre, preserved by careful dyeing, with a beautifully figured water-mark through it, is identical with the curly "Persian Lamb" fur derived from a good Karakul-Duzbai, but is obtained at an earlier stage of development. The pelts are in consequence scarcely half as large, although often more costly, ranging in price from £1 10s. to £3 each. The skins are those of prematurely born lambs thrown by the ewes that suffer from a disease known as "djut," and although brought into the world alive the lambs generally are so frail and weak that they would certainly die within a few hours. It is necessary to kill, bleed and skin them as quickly as possible to preserve the quality of the fur and the wearing power of the skin when cured, as well as to prevent injury to the skin when pulling it off, which might easily reduce its value by 50 to 75 per cent. At the best the skins of "slinks," although often very beautiful, are fragile and have little wearing power, being liable to crack during use. Even the best "Broadtail" skins, although much more costly, fall far short of the durability and wearing quality of "Persian Lamb" skins.

FIG. 5.—The Cream of some sixty Head of Karakul sheep selected by Dr Young: twenty-one of them went to Prince Edward Island.

FIG. 6.—Karakul Ewe and Lamb in Prince Edward Island.

There are three ways of preserving lamb-skins in preparation for transit: (1) drying them, by toggling without stretching when quite green in a shady place away from the direct influence of the sun; (2) salting them and placing them for a night in heaps of pairs with the green sides put together, the surplus salt being shaken out in the morning and the skins being exposed to dry; and (3) in Bokhara, pickling them in coarse barley flour by a patent process in high favour with certain pickling firms, who guard their secret carefully.

In Asia "Persian Lamb" skins are never dyed, and those most directly descended from the fountain head of blackness retain their colour without fading into brown when exposed to the sun as the black wools of English and Australian sheep are liable to do. In Europe and America all black lamb-skins are dyed black to make certain that the colour will not fade, and also to intensify the natural lustre. No mode of dyeing will, however, give lustre to a wool which is not by nature lustrous. It is this remarkable quality of lustre which has brought lamb-fur into fashion and is the infallible guarantee that public appreciation is of a permanent kind.

Skins with tight grey curls are very rare and bring from £2 2s. to £5 5s. each; they are classed as Shiraz. Grey Crimean ("Krimmer") skins are used in Russia for the requirements of the private soldier, and in other parts of the world for ordinary fur purposes. The curly locks are somewhat large and more open than those of "Persian Lamb," although there is great variation in this particular, due to the amount of fine-wool blood present in the producing sheep. The wool of Grey Crimean sheep is uniformly grey and its origin can only be conjectured. The sheep have been in the Crimea for half a century and are supposed to have come from Bokhara *via* the Caucasus.

Not infrequently may be seen Karakul fur in which grey hair is intermixed. Local fur dealers call it grey "Shiraz." Grey lamb-skins when dyed do not develop the lustre or take the dye so satisfactorily as black skins of similar quality, though the dark brown skins do.

The origin of the dark pigment in Karakuls and other strains of Asiatic sheep is believed to have been the Black Danadar which is now practically extinct in Bokhara, though a few grey Danadars still exist near Kedjumek. The Black Danadar always remains black from youth to age, not becoming grey as do the Arabi and Karakul-Duzbai. The Black Danadar, the "Look Nakbo" of Tibet, according to

Young, is a small sheep, with a small head, small erect ears, small thin feet and a long tail reaching to below the hocks. Its wool is very lustrous, strong, though not coarse, and wavy in the adult, the wool being shorter than that of the English long-wool. The curls of new-born lambs are very fine in texture, but are not specially tight.

The Karakul Sheep Industry in Bokhara.—The Karakul sheep industry centres in the foothills of the mountains that form the southern boundary of Bokhara, the cultivable land in the valleys being utilised for gardens and orchards. The flocks are driven in autumn, when the first snow falls, from

FIG. 7.—Karakul-Duzbai Ram at the Farm of the Edinburgh and East of Scotland College of Agriculture.

their summer quarters on the higher plateaux into the "Kishlaks" of the valleys. They are kept there until the lambing season is past, and in early spring they are driven back to the higher desert grazings which are unsuited to cultivation. The sheep are kept always in the open, and during winter are more or less protected from the cold winds in the hollows of the mountains and live mostly on dry stalks kept clear of snow by the wind.

To give the lambs a good start in life, the lambing season is regulated to come when there is an abundance of plants and flowers to develop the plentiful supply of milk that the ewes are capable of yielding. The time of lambing is determined

by tying an old rag round the belly of the rams to form a screen, which renders him incapable for the time being. In Bokhara the lambing season extends from January to May, with the busiest period in March and April. One ram unattended may not suffice for more than 30 to 50 ewes during the season on account of the difficulty presented by the ewes' fat tails, but, when rams are properly looked after, coupling becomes more certain and one ram may settle 70 females.* A ram can remain in service for from 8 to 12 years, and ewes live from 7 to 10 years. The liberal supply of mother's milk

FIG. 8.—Head of the Ram shown in Fig. 7.

in youth and the abundance of "saline bitter pastures" combine to develop in the Karakul-Duzbai a big sheep, the ewes often weighing 200 lb. and the rams over 300 lb.

After midsummer, the lambs kept for breeding are weaned. The ewes continue to give a considerable quantity of rich, delicious milk till late in the autumn. The famous "Brinza" cheese, which is greatly esteemed in southern Asiatic Russia, is made from it to the amount of 30 lb. to 40 lb. from each

* George Rounnel, of the U.S.A. Department of Agriculture, puts the number at 123 ewes under a system of hand breeding.

ewe. "The people of Bokhara claim that the milk from Karakul sheep is the richest and most nourishing obtained from any living animal."

Good fur-producing Karakuls are found only in very limited numbers and on certain ranches owned by Bokhara noblemen, who, however, do not even make an attempt to prevent in-breeding or to secure the elimination from the breeding stock of Afghan blood, which is indicated by the fine, downy wool underneath the hairy fleeces. The result is that good sheep and good lamb furs are steadily decreasing in numbers and are believed to be within measurable distance of extinction. The limit of production has long ago been reached in Bokhara. The figures showing the quantities of skins collected there annually vary somewhat round about 1,500,000 "Persian Lambs" and 100,000 "Broadtails." The actual figures for 1911 and 1912 are as follows :—

"Persian Lamb" skins collected in	1911	..	1,500,000
,, ,, ,,	1912	..	1,814,000
"Broad-tail" ,, ,,	1911	..	100,000
,, ,, ,,	1912	..	35,000

The increase of 314,000 "Persian Lambs" and the decrease of two-thirds of the usual number of "Broad-tails" collected in 1912 were due to favourable climatic influence. The average annual value of this export trade has been estimated at approximately £1,000,000.

Colonisation of the Karakul Breed.—It was at one time asserted that only on the steppes of Asia would the Karakul sheep retain the curly character of its coat, and that on land where the ewes wander outside the natural districts the characteristics were gradually lost with the second, third and fourth lambs; and it was, therefore, considered doubtful if the valuable qualities of the fur could be maintained in the case of lambs bred in Europe and America. This opinion was probably the result of imperfect observation, as Asia contains many sheep which do not possess the characteristics peculiar to the Karakul, and which may have provided the sires of later lambs.

There are instances on record of more or less successful breeding of Karakul sheep for their lamb-fur in all the great continents. About 16 years ago the first flock of Karakuls was imported into the Crimea, and they have done well.

In 1902 Councillor Paul Thorer, the senior partner of Theodore Thorer, one of the largest and oldest established of the fur merchants of Leipzig, became interested in the possible

FIG. 9.—Cheviot Ewe and her Karakul Cross Lamb, showing a very poor Type of Fur.

FIG. 10.—Blacktace Ewe and her Karakul Cross Twin Lambs, 3 days old.

FIG. 11.—Karakul—Blackface Cross Lamb, 2 days old, valued by

advantage of the propagation of Karakul sheep in German colonies. He enlisted the sympathy of the King of Saxony, and the idea was taken up by the Director of the Agricultural Institute at Halle. In 1903, 4 rams and 26 ewes of what were believed to be pure Karakuls were secured from Bokhara and were established on a farm at Lindchen, in the Mark of Brandenburg, while two years later another small lot was obtained. Experiments proved that "at least no deterioration in quality could be shown to exist in the lambs born of the original imported sheep." Some German landowners subsequently made an attempt to breed Karakuls for fur, but the high cost of feeding is a serious drawback to development. It is, moreover, to be feared that the sheep imported had not been selected with a view to the complete exclusion of fine wool, for Dr. Young reported in 1912 that he "examined 60 ewes descending from Thorer's flock and only found three of them void of the fatal down-like underwool." Karakul sheep were also introduced to the sandy districts of the northern plains with the intention of increasing the value of the poorer parts of Germany. The Rhoen sheep gave the best results, but not till the seventh top-cross of pure Karakul ram.

In order to introduce the sheep to the Trans-Caspian districts the Russian Department of Agriculture established some 13 years ago a State sheep farm, picked ewes and rams being brought from Bokhara. The wrong type of sheep seems to have been procured, as Dr. Young after examining some 1,500 so-called Karakuls on this station reports that he "did not find one fur-producing sheep" (he meant, of course, of good Karakul quality and free from fine wool), "all being Arabi-Afghans." A number of stud rams and ewes are, nevertheless, sold annually to the inhabitants of the surrounding country, as well as to other breeders.

Karakul sheep have been drafted into the Kuban district, towards the north-west of the Russian province of the Caucasus, bordering on the Sea of Azov. Where these have been crossed with local breeds, soft-wool sheep must have been more or less rigidly rejected. Dr. Young reports that each ewe produces one or two lambs, the skins of which fetch from 1 to 2 guineas, and, in the case of good skins, 3 guineas. According to the Poltava Agricultural Society's prices, ordinary breeding Karakul sheep sell at from 6 to 8 guineas, but those known to give specially good results cost from five to ten times as much.

Dr. Young throws valuable light on the position of the trade in the distribution of rams, and of their prices and quality,

in a report on the sale of 90 Karakul rams among other Asiatic sheep which took place at Moscow in October, 1912. Many were sold at 8 to 30 guineas and even 60 guineas each, although the best tight-curl producers were few. In the great majority of cases there was evidence of a strain of the white fine-woolled Afghan, a type of wool that seriously injures the formation and the tightness of the curl as well as its lustre. The impurity of blood was indicated by the soft wool on the head, neck, abdomen and body, and even on the lower extremities of the limbs, which in the true fur-producing sheep are always covered with very lustrous, jet-black, stiff hair, similar to the hair of the face and ears. There were only about 10 of the best fur-producing sheep in the consignment.

The most extensive venture in introducing Karakul sheep to a distant country was made in January, 1909, when 252 ewes and 22 rams were shipped to German South-West Africa from Bokhara. Within a few months of landing the greater part of them were reported to have succumbed to blue-tongue and catarrhal fever. Of the few that were saved the lambs did well, and it is now understood that the industry is an established success and that the sheep have found climatic conditions on the higher plateaux of German Damara Land and Namaqua Land which are not far removed in certain particulars from those of their original habitat.

Perhaps the most remarkable, if not the largest, colonisation of the Karakul breed was effected in Texas by Dr. Young. In 1908 he introduced 15 pure-bred Karakuls, about 8 guineas per head being paid for 10 ewes and 10 guineas each for 5 rams; only one ram, however, bred true to type and produced good skins. The estimated cost, with travelling and other expenses included, was not far short of 200 guineas per head before they finally reached their destination. The time occupied was 14 months and included 9 months' quarantine, first in Russia and finally at the Federal quarantine station in New Jersey to avoid the dreaded danger of introducing surra, or some other little understood Asiatic disease. No trace of any disease was found, nor was it likely to be in sheep from such a healthy country as Bokhara, where surra does not exist. The wonderful hardiness of the breed, as compared with other large long-wool breeds, was demonstrated by the fact that through the trying ordeal of the long and tedious journey, including incarceration for over 3 months in a dark barn, none of the original animals, nor any of the 7 lambs

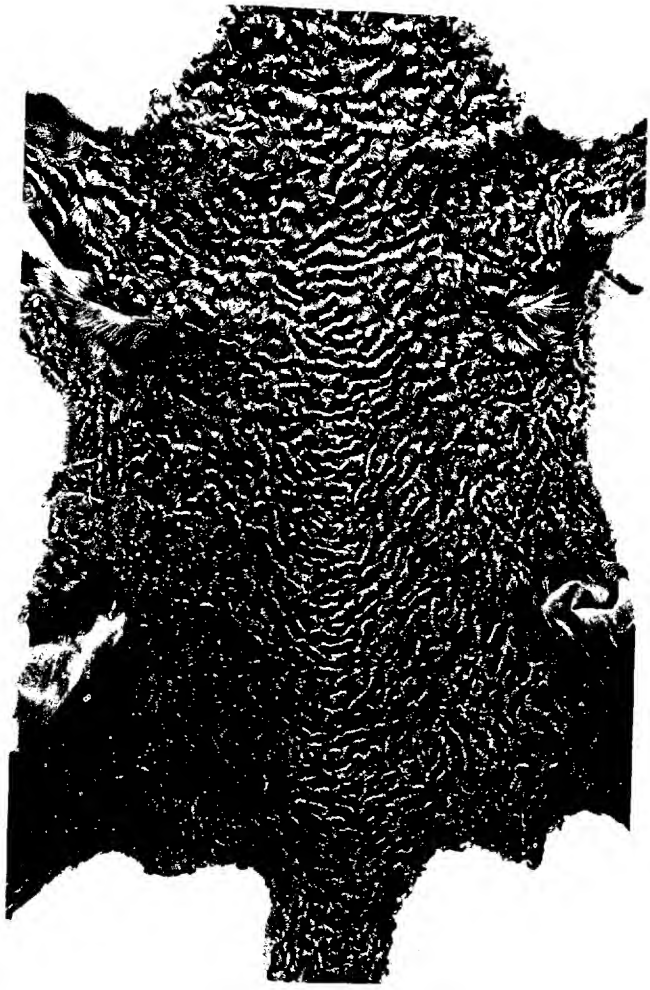

FIG. 12.—A "Persian Lamb" Fur of exceptionally fine quality, taken under 3 days old. The photograph was lent by Mr. Ernest Poland.

born at New Jersey, making a total of 22, died on the way. Darkness was believed to be necessary to test for the presence of surra.

Until comparatively recent years it was practically impossible to get any Karakul sheep out of the country, and, even now "the Authorities of Bokhara put every obstacle in the way of foreigners attempting to export the valuable animals." To make the position still more difficult, the Emir has recently issued an edict absolutely forbidding the exportation of Karakul sheep, and none are supposed to have left the country since, except those obtained by the various agricultural societies of European Russia.

Owing to these difficulties and the fact that the Bokharan traders will, if possible, provide Karakul-like cross-bred animals in place of the pure-bred sheep that would breed true, it is an extremely uncertain undertaking to secure the genuine Karakul sheep, even for those willing to pay a good price. Dr. Young got his sheep by means of letters of introduction to the Russian Government from ex-President Roosevelt and Secretary Root, but only with the greatest difficulty.

In 1911 Dr. Young's flock had increased to 56 in number, and eventually a Karakul Sheep Company was formed to take them over. Pure-bred Karakul rams were bred to a number of high-grade long-wools, including Lincolns and Cotswolds as well as close-woolled Merinos and Downs. The long-wool results proved so satisfactory, and especially the Lincoln cross, that 1,000 high-grade Lincoln ewes were secured and bred to Karakul rams in 1912.

A second importation, consisting of 11 rams and 6 ewes arrived in quarantine at Baltimore in March, 1913; one valuable ram died in quarantine, which left rams of only 7 unrelated high-class blood lines in America. Five of the rams were bred to 400 Lincoln, Highland, Blackface, Leicester, and other long-wool ewes, including a few Karakul ewes, but the result of these tests has not been made public.*

The United States Bureau of Animal Industry conducted experiments by crossing a selected Karakul ram with ewes of the Barbado breed (a cross from the Barbary). The Barbado second cross was entirely satisfactory, and a beautifully smooth, figured, rich, velvet-black skin was produced. Dr.

* Since the foregoing was written Dr Young succeeded in getting out in the end of July, 1914, another specially selected lot of about the same number as the first lot of sheep exported, in spite of the existing embargo upon foreigners entering the military zone of Bokhara. They left Libau by the last steamer for New York before the outbreak of the war, but six rams were lost through an outbreak of fire in the quarantine station in the spring of 1915.

Young obtained excellent results from breeding Karakul rams to high-grade, fawn-coloured Persian fat-rump ewes that were imported into the United States a little earlier than his own sheep, and were free from fine wool.

The Young Karakul Sheep Co., Ltd., Charlottetown, P.E.I., Canada, has had some promising results by breeding with Scotch Blackface ewes, but the humid climate is a hindrance to progress.

Experiments in Scotland.—An interesting experiment was initiated under the auspices of the Edinburgh and East of Scotland College of Agriculture and the Board of Agriculture for Scotland, when a Karakul-Duzbai ram was bought for £100 in the autumn of 1913 through Dr. Young from what he pronounced to be the best flock of fur-producing Karakuls in European Russia. In characteristic breed points the ram conformed closely to what is looked for in a Karakul ram of high breeding, with the exception that he had scurs in place of horns and that slight traces of fine under-wool were to be found, especially near the root of the tail and about the ears. He was mated, though a little late in the season, to 37 selected pure-bred ewes belonging to the following British breeds :—Scotch Blackface, Border Leicester, Romney Marsh, Herdwick, Cotswold, Dartmoor and Cheviot. The tup worked well and got 40 lambs—all without exception black and curly, though the curls differed in degree of tightness. The lambs showed pronounced Karakul characteristics, including, with one exception, drooping ears and a rudimentary fatty enlargement near the base of a long tail. In two cases only the tail had a white tip, which was correlated with a white spot on the forehead.*

The lustrous, tightly-curled fur, which the best of Dr. Young's rams produced in the first generation, did not appear ; but the ewe lambs, with a single exception, have been kept.† Within four or five generations of sheep it should be possible to produce a high-grade Karakul-Duzbai even superior to the original pure breed, and to develop rams, made "pure by crossing" by the use of pure-bred sires, that would breed true to type and be of even higher quality and of greater value than the sheep which can be bought in the market at present.

* A report on the considerably extended trials of 1914-15 is not yet available.

† It was intended to breed them to a pure-bred Karakul buck in the autumn of 1914, but the expected ram was detained at Libau on the outbreak of war, and he died of a disease said to have been induced by close proximity to the sea.

Conclusion.—Unqualified success in fur breeding, although now believed to be certain, is coming more slowly than might have been anticipated. The prospects of establishing a new meat industry in this country are, however, most encouraging. The carcasses of the ram lambs, which weigh from 8 lb. to 10 lb. each when 75 to 80 hours old, have proved to be a rare delicacy, which would doubtless soon become appreciated. There is no reason why Karakul "baby lamb" should not be received with the favour attending "baby beef," and command the remunerative price of 3s. per lb., thus providing a solid basis on which a British Karakul lamb-fur industry might be reared.

The interest of the scientific world is so new in connection with this industry, and there is such a wide gap between the fur breeder in Asia and the fur merchant and fur wearer in Europe and America, that much uncertainty prevails as to the origin and history of the best fur-bearing sheep and the most successful way to conserve and develop them. Opinions are only now being formed and reliable information is slowly taking the place of what was mere conjecture or romance. The subject is not only of value from the scientific point of view, but there is great scope for the development of its commercial as well as its æsthetic aspects, and there are sufficient guarantees that the business of sheep-fur production, now in its infancy, is likely to expand to almost indefinite proportions.

The writer wishes to acknowledge his indebtedness to Dr. C. C. Young, Mr. Ernest Poland, and the Edinburgh and East of Scotland College of Agriculture for kind permission to reproduce the photographs illustrating this article.

Fruit Preserving for Small Market Growers or for Domestic Use.

ALTHOUGH the fruit crop this year is not likely to be so large as it was in 1914, the need for avoiding waste and for making full use of all garden produce is perhaps greater, and, in view of the appeals that are being made to economise in food supplies obtained from abroad, everything possible should be done to conserve the supplies grown at home.

One of the most important methods is the preservation of fruit, and small growers and householders should take the greatest pains to ensure that the whole of their produce is utilised. If threatened with any disease it should be gathered as soon as it is possible to put it to any profitable use. Even slightly diseased fruit

can, if properly treated, be made acceptable for home consumption, though it should not be sold. Fruit can be (1) made into jam, (2) bottled, or (3) dried.

1. *Jam-making.*—The methods for making jams at home are generally known and widely practised in England, and no detailed instructions are necessary. Owing to the scarcity of sugar, which is entirely imported, householders are recommended to make use of glucose, which is very largely manufactured in England. Good results may be obtained by using one part of glucose to two of sugar. Glucose can be obtained in large quantities from the manufacturers, or in small quantities from confectioners.

2. *Fruit-bottling.*—The best method of preserving fruit without the use of sugar, glucose, or any other added preservative, is to sterilise the fruit in bottles.

Vacuum Process.—A proper sterilising apparatus, including a dozen bottles, could be bought before the war for about 14*s.*, but as the price of glass bottles has increased recently, a similar outfit will now be rather dearer. The bottles are constructed so that they can be hermetically sealed with either glass or tin caps, and alone formerly cost about 3*s.* 6*d.* to 4*s.* a dozen. The apparatus is convenient but not really necessary, and the process can be carried out in a fish kettle or a large, deep bowl or pan, but in this case householders are advised to stand the bottles on a false bottom, such as a piece of wood or a layer of hay, to avoid the risk of cracking the bottles.

The process of sterilising consists in filling the bottles with fruit, which must, of course, be prepared for the purpose by removing the stalks, etc., adding water to within half an inch of the rim and putting them in the steriliser, the temperature of which should be slowly raised to about 165° F. or 170° F., and kept at that point for about 10 minutes. The bottles should then be securely fastened down, being screwed or capped according to the system adopted, and allowed to cool. In this way a partial vacuum is secured in the bottles, and no harmful germs from outside can obtain entry if care is taken to ensure that the bottles are airtight.

Bottling in Ordinary Bottles or Jars.—If any difficulty is experienced in getting the proper types of bottles, ordinary glass jars may be used under the following conditions. If suitable corks or bungs can be got to fit the bottles, the fruit may be sterilised as described above, the cork being immediately pressed down tight and tied securely in its place. It should then be

coated with a layer of paraffin wax.* If, however, the glass jar has no such stopper, it can be sealed by pouring in, until full to the rim, immediately on removal from the steriliser, a thick layer of melted fat, or of a mixture made of 8½ parts of vaseline and 1½ parts of paraffin wax previously melted by warming. The melted fat or wax remains on the surface of the water in the bottle and on cooling solidifies and forms a thick seal. After the bottle has cooled the wax may be found to have contracted slightly in the neck; in this case it is well to pour on a further quantity of wax to fill the neck to the rim. The mouth of the jar should then be covered with parchment, such as is used to cover jam pots, and be tied firmly down. The filled jars should be stored in a cool room till required for use. Where ordinary bottles or jars are used it may be desirable to heat the contents to a rather higher temperature than that used in the vacuum process. The essential point in either system is that air containing harmful germs or spores of fungi should not be allowed to reach the fruit after sterilisation. So long as the seal used in the case of ordinary bottles remains perfect the fruit can be kept as successfully as in the vacuum process, but the seal may become damaged or may tend to crack owing to contraction of the wax, and germs may then obtain entry to the fruit. Bottles treated in this way should, therefore, be examined from time to time, and if imperfections in the seal are noticed they should be remedied.

The best fruits for bottling, whether by sterilising or otherwise, are gooseberries and plums, including damsons and stone fruit of this class. It is generally considered that the flavour of plums is improved by bottling. Any kind of fruit can be sterilised, if the necessary precautions are adopted, but it is improbable that it will be worth while to bottle apples or pears during the season of 1915.

3. *Fruit Drying.*—Directions were given in this *Journal*, September, 1914, p. 548, for drying plums and apples. The crops will probably not be heavy enough to make this process profitable this year, and it may be difficult to get the necessary apparatus.

4. *Prune-making.*—A simple method of dealing with plums is known as prune-making. By this method the sugar in the plum is used in preserving the fruit, and there is less risk of subsequent decay if the fruit gets damp.

* This can be obtained from most chemists and should be melted and applied with a brush. Hard paraffin wax should be asked for. If this cannot be obtained a wax candle may be melted and used.

The apparatus in this case is of the simplest character, a few shallow trays being all that is required if the fruit is to be dried in an ordinary oven. A special apparatus can be obtained, if desired, for about £3.

Ripe fruit should be selected, but it must not be over ripe, or decayed or injured in any way. The temperature of the oven when the plums are first put in should be about 100° F.,* and the fruit should be kept at this temperature for about 8 hours. Care should be taken to examine the fruit from time to time, since after a few hours it begins to swell. The fruit should be watched and should be taken out before the skin bursts and replaced when the puffy appearance has subsided.

At the end of the first shift the trays should be taken out and the fruit allowed to cool. The oven should then be heated to a temperature of about 130° F. and the trays replaced for a second shift of from 8 to 10 hours, at the end of which time they should again be withdrawn and allowed to cool. The fruit should then be turned by placing an empty tray upside down on the top of a full tray and reversing them together. The oven should next be heated to a temperature of 170° F. and the trays inserted for a third shift of 8 hours. This should be continued till the fruit is dried, but the more slowly it is done the higher is the quality of the prunes. Some plums dry more quickly than others and these should be removed as soon as ready. The fruit when cool should be graded and packed in boxes and then stored in any place where a perfectly dry atmosphere can be secured.

The Making of Fruit Pulp.

As an article of food, fruit is generally used fresh, but there are various methods of preserving it, such as jam-making and fruit-bottling,† which make it available when fresh fruit cannot be obtained, and which in seasons of heavy crops form a valuable means of preventing waste. Among such methods "fruit-pulping" is not so widely known as it might be, but specially merits attention on account of its simplicity. It consists in reducing the fruit to a state of pulp by heat, generally by means of steam. The treatment sterilises the fruit, so that it may be kept under suitable conditions without decomposition for an indefinite period. The product is known as "fruit pulp." The process can be carried on by any grower who has on his premises an ordinary steam boiler.

* A thermometer registering to 250° F. and cased in metal can be purchased for about half-a-crown.

† See also Leaflet No. 250 (*Fruit Bottling for Small Holders*), and Special Leaflet No. 5 (*Fruit Preserving for Small Market Growers and for Domestic Use*), published above.

Uses of Fruit Pulp.

Certain kinds of fruit pulp, such as apple, plum, damson, gooseberry and raspberry, are already made extensively in this country. Other kinds, such as apricot, are imported in quantity from countries where the kinds of fruit required are grown on a large scale and are cheap.

Fruit-pulp is chiefly used in jam-making. It is converted into jam where convenient to the manufacturer.

In recommending the making of fruit pulp the Board do not intend to suggest that the use of fresh fruit for jam-making should be curtailed. When possible, fresh fruit should be used for jam-making, since the product is superior and the expense of pulping as a preliminary to jam-making is avoided. Pulping is, however, a useful supplementary method: by its means larger quantities of fruit can be preserved, waste will be lessened, in plentiful seasons prices may be better maintained, and by the use of pulp stored up in seasons when fruit is cheap the cost of jam-making will be reduced in seasons when fruit is scarce.

Manufacture of Fruit Pulp.

Outfit.—The essential requirements for the preparation of fruit pulp on a commercial scale are a steam boiler, and barrels, tins, drums, or jars, in which the pulp can be stored. The best qualities of pulp are stored in large stone jars, but these are expensive. The quickest and most convenient method of storage on a farm is to use casks. Casks which have contained wine or spirits are usually employed. They should be in good, sound condition and preferably made of oak. Copper ladles and funnels are required for filling the casks.

Method of Making.—In a jam factory, pulp is usually prepared in the steam-heated pans otherwise used for boiling jam, but in the absence of special jam-making machinery the method here described may be adopted.

Three wooden vats, tubs, or half barrels should be placed in a row in a position convenient for connection with existing steam piping. Whilst the contents of one vat are being steamed, a second will be in process of filling, and a third being emptied, so that with a sufficient head of steam the process of pulping will proceed continuously. A coil of 1-in. copper piping is required. This should be pierced with not more than 20 $\frac{1}{8}$-in. holes. The coil should be placed in the vat or tub so as to reach to within a few inches of the bottom, and the pipe connecting it with the boiler should be fitted with a rapid coupling so that the coil

may be quickly transferred from one vat to the next. For continuous working two such coils are required, as it is not possible to insert a coil amongst the fruit after the vat has been filled. The vats should be provided with wooden covers to confine the steam whilst the steaming process is going on. With an 8 h.p. boiler working at a pressure of 45 lb., three vats of 100 gal. capacity can be kept in fairly continuous use. Five cwt. of plums or apples may be cooked at a charge, and, if steam can be maintained, three charges may be put through per hour.

Steam is also required for scalding out and sterilising the interior of the barrels before filling them with pulp.

The process of sterilisation is completed by burning a rag dipped in melted sulphur within the bung hole, and the bung is then kept closed until the barrel is ready for filling.

The casks must be completely filled and bunged down whilst the pulp is boiling hot, and placed in a position where they can be kept undisturbed until the pulp is required for use. They should lie on their side with the bung uppermost, and if there is any sign of fermentation a small hole should be bored in the wooden bung and closed with a spiggot. The latter should be lifted daily until fermentation has ceased and the contents of the cask have settled down.

If the casks are subsequently moved, the same process of daily opening the same hole in the bung must be repeated.

If tins or jars, after previous scalding, are filled with boiling pulp and at once hermetically closed, the contents should keep indefinitely without fermentation. Tins used for pulp should be well lacquered inside.

Addition of Water.—In making *plum* pulp by the above method there is no necessity to add water. Five cwt. of plums may be placed in the vat and the steam turned on for 10 minutes. The contents of the vat should then be thoroughly stirred, and the steam turned on for a further 10 minutes, at the end of which time the pulp should be ready. It is essential that not only the flesh but also the kernels of the plums should be thoroughly cooked and sterilised.

In making *apple* pulp a certain amount of water must be added, varying with the character of the apple. In the case of hard apples about 3 gal. of water should be sufficient for each cwt. of fruit, since more steam will be condensed than in the case of soft and easily cooked apples, to which rather more water may be added. After steaming for 15 to 20 minutes the apples must

be rubbed through a sieve of a mesh sufficiently small to retain the pips. The pulp must be again brought to the boil before finally storing in casks.

Autumn and Winter Fodder.

IN view of the short crops of hay obtained in some parts of the country farmers are naturally anxious to increase their stock of winter fodder. Considerable areas of aftermath are consequently being saved for cutting. This will to some extent reduce the area available for late grazing, and it becomes necessary to consider, especially in the event of a dry autumn, how a shortage of grass can be made good.

Maiden Seeds.—Sometimes a fair amount of autumn keep is furnished by "maiden seeds," but great care is necessary in the grazing of this crop if its future is not to be endangered. After the covering crop has been harvested the "seeds" should be rolled as soon as the implement is likely to make any impression on the ground. This will effect consolidation and promote tillering. Further, before being depastured the plants should be allowed to establish a firm and fairly deep root-hold as a precaution against winter frost, spring drought, and the risk of being uprooted by stock. At the same time, if a short-lived plant, such as red clover, be allowed to reach or even approach maturity in its first autumn, the chances are that, by spring, much of it will have died. Grazing will check this and encourage branching of such grasses as may have been included in the "seeds" mixture.

Straw.—It is generally possible in winter feeding to replace hay either wholly or partially by straw. For this purpose the straws in common use are those of oats, barley and wheat. One of the chief functions of straw in a ration is to provide the bulk necessary to the well-being of a ruminant animal. The nutritive value of straw is usually low, but much depends on the degree of ripeness of the crop when harvested. The riper the straw becomes the greater is the transference to the seed of the most valuable nutritive matters, and the tougher the straw is to masticate. In general, the straw of spring-sown cereals is less fibrous than that of winter-sown and is consequently more nutritious. Oat-straw is generally considered the most suitable for feeding, but barley straw, particularly if it contains a proportion of grass and clover plants, also forms useful fodder. Cereal straw is relatively rich in carbohydrates and uniformly poor in

albuminoids, and consequently in feeding straw to stock the farmer's chief concern is to augment the proportion of albuminoids in the ration. This can best be done by the addition of cakes or meals rich in that constituent.

The most economical way of feeding straw is to give it in the chaffed condition, mixed with other more nourishing and appetising food. For cattle it is usually mixed with sliced or pulped roots, crushed cake or meal, and treacle water, and allowed to stand overnight. A slight fermentation sets up which softens the straw and further adds to the palatability of the mixture.

In order to save straw for fodder the extended use of bracken and peat-moss as litter is desirable.

Potato Tops.—The crops commonly used for supplementing bare pastures are vetches, maize, cabbages, early turnips and mangold leaves, but where a sufficiency of these is not available, potato tops might be tried.

In times of stress farmers on the Continent frequently have recourse to potato tops as fodder for cattle. The tops should be cut soon after they begin, normally, to turn yellow, and be fed on grass land, but, as a precaution against the transmission of disease to future crops through the dung, should not be fed on grass which is to be broken up for potatoes in the following year. Green tops should be used very sparingly, preferably after being dried in the sun and wind. Tops bearing many blossoms or unripe fruits should be avoided, as these contain an undue amount of a poisonous principle.

The tops should be collected as free from earth as possible and be fed in small quantities along with other food.

White Mustard grows very rapidly and may be broad-casted upon stubbles broken up by the cultivator or disc harrow. Sown as late as the end of August mustard will usually yield good food by the end of November. If not required for sheep feeding the crop may, with advantage, be ploughed in as green manure. From 14 to 16 lb. of seed, together with 1½ cwt. of superphosphate per acre, should be sown.

Reeds.—Another plant not to be despised in times of shortage is the reed. The common reed (*Arundo phragmites*), which grows luxuriantly in wet or marshy places is mainly used, if at all, for thatch and bedding. The straw is too coarse and brittle to make really good litter, but is admirably adapted for thatch, and where available may well be used for this purpose instead of ordinary straw. For feeding purposes

young reeds are suitable. The tops of the shoots are tender and succulent, and are readily eaten by stock. As the plant matures, however, it becomes almost incapable of digestion, and unless specially treated would be quite unfit for food. During June and July the more tender portions of the plant may be dried and chaffed, and fed instead of straw. Later the greener portions may be converted into silage, and thereby softened and rendered more palatable.

Care, however, should be taken to feed only small quantities along with roots and concentrated feeding stuffs.

Gorse or Furze, which grows naturally on waste places, was used formerly in this country as food for stock, and was even specially cultivated for that purpose. Two types are commonly met with—the ordinary prickly gorse, and "French" or foxtail gorse, which is relatively free from spines. The latter requires less preparation for stock-feeding and is, therefore, generally to be preferred, but ordinary gorse, once it has been thoroughly pulverised, may also be fed to stock with good results.

Gorse possesses the great advantage that it can be grown on poor, thin soils where other plants would fail, and it will greatly improve such soils by its growth. Naturally, however, it thrives best on good, well-drained soils: it will not do well on cold clays or damp peaty soils, or on chalk.

Where foxtail gorse is specially grown for fodder the seed is drilled in rows 12 to 24 in. apart in April or May, on clean ground, at the rate of 12 to 15 lb. per acre. Gorse seedlings are slow in growth, and it is most important, therefore, that weeds should be kept in check. The first cutting is usually made in the second winter after sowing, from November to the end of February. Thereafter the crop may be cut annually or biennially as found expedient.

In an experiment conducted on light, sandy land at Woburn "French" gorse yielded 11 tons per acre in its second winter.

Before being fed to stock, gorse is generally crushed between rollers, or otherwise pulverised. It should not be allowed to lie for long in bulk as it ferments and quickly becomes sour and unpalatable. In the case of old-established gorse only the green tops are fit for feeding. Old gorse covers, however, may be reclaimed by cutting down the woody plant, as close to the ground as possible, and freely dividing the roots. Subsequent young growth will be available for cutting at one or two years' growth, as may be required.

Gorse is a highly nutritious fodder, and has proved satisfactory with all classes of farm live stock, more particularly

with horses and milch cows. It should form, however, only part of the ration, as when fed in excess it proves too heating. This effect may be counteracted by giving occasionally a bran mash or a daily allowance of roots. Horses and cows may receive up to 20 lb. per head daily. In the Woburn experiment already referred to the gorse was put through a gorse-cutter and fed to sheep on swedes. In the fresh state the sheep ate, readily, up to 2½ lb. per head daily, and throve well upon it.*

Particulars in regard to Catch Crops to come in for use in early spring will be found in Special Leaflet No. 28. (*Suggestions for the Cultivation of Catch Crops and Home-Grown Feeding Stuffs.*)

Notes on Feeding Stuffs in August: From the Animal Nutrition Institute, Cambridge University.

THESE notes should be read in conjunction with the notes in the last five numbers of the *Journal*, where the meaning of food units and the method of compiling the table of prices and values is explained.†

Feeding stuffs have, on the average, altered little in price since last month. Individually, however, there have been several noteworthy changes. Wheat offals, especially sharps and middlings, are considerably dearer, and bran has also gone up slightly. Argentine maize has dropped considerably. Malt culms and wet brewers' grains are cheaper. Oats have gone down appreciably, but are still so dear as to be out of the question except for very special purposes.

Undecorticated cotton cake is again dearer, and at its present price is a most uneconomical food to buy. It is far dearer per food unit than linseed cake, although the latter is still rising in price. At present prices decorticated cotton cake is very cheap per food unit, and so are the less known cakes made from palm-nut kernels, coconuts, and soya beans. These latter will no doubt be further used as their feeding properties get better known. Palm-nut kernel cake was used for fattening oxen at the Norfolk Agricultural Station last winter with considerable success. Mixed in equal proportions with cotton cake it was given to oxen at the rate of 7 lb. per head per day, along with normal rations of chaff and roots.

* Dr. J. Augustus Voelcker: *Journal R.A.S.E.*, Vol. X., 1899.

† This *Journal*, March, 1915, p. 1111; April, 1915, p. 52; May, 1915, p. 148; June, 1915, p. 248; and July, 1915, p. 322.

Feeding Stuff.	Reckoned from digestible nutrients.		Approximate prices per ton at the end of July.				Approximate prices per Food Unit.			
	Nutritive Ratio.	Food Units.	London.	Liverpool.	Hull.	Bristol.	London.	Liverpool.	Hull.	Bristol
			£ s. d.	£ s. d.	£ s. d.	£ s. d.	s. d.	s. d.	s. d.	s. d.
Soya Bean Cake	1 : 1·1	122·3	8 3 9	8 7 6	8 0 0	8 5 0	1 4	1 4½	1 3½	1 4½
Decorticated Cotton Cake	1 : 1·3	126·3	9 5 0	10 10 0	—	10 5 0	1 5½	1 8	—	1 7½
Indian Linseed Cake	1 : 1·9	123·1	10 5 0	10 5 0	10 2 6		1 8	1 8	—	—
English Linseed Cake	1 : 2·0	120·1	10 15 0	11 5 0	10 5 0	10 17 6	1 9½	1 10½	1 8½	1 9½
Bombay Cotton Cake	1 : 2·4	65·3	—	7 0 0	—	7 0 0	—	2 1½	—	2 2½
Egyptian Cotton Cake	1 : 2·0	71·9	6 15 0	7 12 6	7 0 0	7 5 0	1 10½	2 1½	1 11½	2 0
Coconut Cake	1 : 3·8	102·6	7 3 9	—	—	7 5 0	1 4½	—	—	1 5
Palm-nut Kernel Cake	1 : 4·0	83·5	6 0 0	5 5 0	5 12 6	6 7 6	1 5½	1 3	1 4½	1 6½
English Beans	1 : 2·6	99·5	9 13 9	10 10 0	9 5 3	9 13 0	1 11½	2 1½	1 10½	1 11½
Chinese Beans	1 : 2·6	101·2	9 18 4	—	—	—	1 11½	—	—	—
English Maple Peas	1 : 3·2	97·2	11 11 0	—	11 11 0	—	2 4½	—	2 4½	—
English Dun Peas	1 : 3·2	97·2	10 4 6	—	9 15 6	—	2 1½	—	2 0½	—
Calcutta White Peas	1 : 2·3	97·5	13 6 8	12 17 6	—	—	2 9	2 7½	—	—
American Maize	1 : 1·1	93·8	7 18 8	9 8 6	—	—	1 8½	2 0	—	—
Argentine Maize	1 : 1·1	94·2	7 4 8	7 12 0	7 11 6	7 9 0	1 6½	1 7½	1 7½	1 7
Maize Meal	1 : 1·3	86·5	8 5 0	8 10 0	8 10 0	7 17 6	1 11	1 11½	1 11½	1 9½
Maize Gluten Feed	1 : 3·3	121·6	7 15 0	—	—	8 5 0	1 3½	—	—	1 4½
Maize Germ Meal	1 : 8·4	99·4	7 15 0	8 10 0	8 7 6	8 10 0	1 6½	1 8½	1 8½	1 8½
English Feeding Barley	1 : 7·8	83·0	10 1 6	11 4 0	10 7 0	10 12 6	2 5	2 8½	2 6	2 6½
English Oats	1 : 7·9	75·4	12 6 8	11 16 0	11 10 0	10 10 0	3 3¼	3 1½	3 0½	2 9½
Argentine Oats (Buenos Ayres)	1 : 7·9	75·4	9 7 10	10 12 0	10 17 3	10 6 0	2 6	2 9½	2 10½	2 9
Argentine Oats (Bahia Blanca)	1 : 7·9	75·4	9 19 0				2 7½			
Malt Culms	1 : 3·6	69·9	5 12 6	6 5 0	5 0 0	6 0 0	2 7½	1 9½	1 5½	1 8½
Brewers' Grains (dried) (mixed)	1 : 3·4	84·5	6 10 0	—	6 10 0	6 10 0	1 6½	—	1 6½	1 6½
Brewers' Grains (dried) (distillery)			7 0 0				1 8			
Brewers' Grains (dried) (fine ale)			6 15 0				1 7½			
Brewers' Grains (wet) (mixed)	1 : 3·4	21·2	0 14 0	—	1 4 0	—	0 8	—	1 1½	—
Brewers' Grains (wet) (ale)			0 15 0				0 8½			
Brewers' Grains (wet) (porter)			0 13 0				0 7½			
Egyptian Rice Meal	1 : 10·3	78·7	—	—	7 5 0	—	—	—	1 10	—
Burmese Rice Meal	1 : 10·3	78·7	6 5 0	6 10 0	—	7 0 0	1 7	1 7½	—	1 9½
Wheat Middlings	1 : 5·3	93·4	8 10 0	—	—	—	1 9½	—	—	—
Wheat Sharps	1 : 5·3	86·3	8 5 0	8 12 6	8 15 0	8 0 0	1 11	2 0	2 0½	1 10½
Wheat Pollards	1 : 5·3	81·9	—	6 5 0	—	—	—	1 6½	—	—
Wheat Bran	1 : 5·3	77·5	6 2 6	6 2 6	5 15 0	5 10 0	1 7	1 7	1 5½	1 5
Wheat Bran (broad)	1 : 4·7	79·9	7 15 0	6 15 0	6 15 0	6 10 0	1 11½	1 8½	1 8½	1 7½

The cattle ate it readily, and made equal increases with a similar lot getting linseed cake in place of the palm-nut kernel cake, other conditions being the same. The cattle were sold by auction at the local market, and, judging by the prices realised per cwt. for the individual animals, the butchers seemed to have a slight preference for the appearance of the oxen fed on palm-nut kernel cake. The present price of about £6 per ton works out at only 1s. 4¾d. per food unit, and at this price palm-nut kernel cake should be largely used for fattening oxen next winter.

Average Prices per Food Unit at the Four Markets of the 31 Feeding Stuffs, shown on page 457.

	s.	d.		s.	d.
Brewers' grains (wet) ..	0	10¾	Wheat middlings ..	1	9¾
Maize gluten feed ..	1	3¾	Rice meal, Egyptian ..	1	10
Soya bean cake.. ..	1	4¼	Maize, American ..	1	10¼
Palm-nut kernel cake ..	1	4¾	Maize meal	1	11
Coconut cake	1	5	Beans, English	1	11½
Wheat bran	1	6¼	Wheat Sharps	1	11½
Wheat pollards	1	6½	Beans, Chinese	1	11½
Brewers' grains (dried) ..	1	6¾	Cotton cake, Egyptian ..	1	11¾
Decorticated cotton cake	1	7	Peas, English dun ..	2	0¾
Maize, Argentine ..	1	7	Cotton cake, Bombay ..	2	1¾
Malt culms	1	7¾	Maple peas, English ..	2	4½
Linseed cake, Indian ..	1	8	Feeding barley, English	2	6½
Maize germ meal ..	1	8	White peas, Calcutta ..	2	8¼
Rice meal, Burmese ..	1	8	Oats, Argentine	2	9
Wheat bran (broad) ..	1	8¼	Oats, English	3	0¾
Linseed cake, English ..	1	9½			

Coconut cake has been tried for milking cows this summer on the University Farm. The cows did not take it readily at first, but by introducing it gradually to their diet they very soon got used to it and ate it well, with satisfactory results as regards their milk yield. At its present price of about £7 5s. per ton it works out at only 1s. 5d. per food unit, and is a very cheap concentrated food for cows. Soya bean cake is by now fairly well known. Oxen do well on it if it is used with discretion. Not more than 2 or at most 3 lb. should be included in the daily ration, and to counteract its somewhat laxative properties cotton cake or some similar astringent food should be included. At about £8 5s. per ton, its present price, or only 1s. 4¼d. per food unit, soya bean cake is, with one exception, the cheapest concentrated food on the market, the exception being gluten feed, which is 1s. 3¾d. per food unit. This latter is a sound concentrated feeding stuff for milking cows.

It may not be out of place to remind those who have to buy in feeding stuffs for the winter that transport is at present very slow, and the delivery of orders left to the last moment

is apt to be so long delayed that it may become necessary to buy whatever can be obtained locally and at a very high price.

Where early delivery is accepted it is necessary to take great care in storage. The building should be dry, and cakes should be raised a few inches off the floor and placed on their edges rather than on their sides, so that as soon as the slightest heat sets in an upward draught of air is caused which dries the cakes and stops the heating.

Suggested Rations for August.

Horses.—August is the month of harvest, and harvest means hard work for the horses. If hard work is expected the feeding must be liberal. It is a very common practice to green soil the horses during harvest. Where leguminous green crops, lucerne, sainfoin, tares or clover are available for this purpose the following makes an economical ration of dry food at present prices: 4 lb. crushed maize, 2 lb. bran, and 1 lb. bean meal. If the green stuff is rye-grass mixture with only a little clover, maize or other non-leguminous fodder, or if the horses are turned out on grass which does not contain much clover, the bean meal should be increased to 2 lb.

When long shifts are worked on dry food it is necessary to water the horses frequently, at least once in 4 hours.

Milking Cows.—At the present high price of milk it is good economy to give a fair ration of concentrated food to cows at grass. If this is not done the milk yield is apt to fall off this month. The following mixtures are suitable at present prices:—1 part coconut cake, 1 part maize and 1 part bran; or 1 part decorticated cotton cake and 2 parts maize; or 1 part maize gluten feed and 1 part bran. The ration should vary according to yield of milk; all cows should get 2 lb. of the mixture per day, and those giving over 2 gallons an extra pound per half gallon.

If lucerne, clover, or sainfoin is available for green soiling the dry food may be reduced to 1½ lb. per head per day, of course with proportionate extra food for the heavier milkers.

If the grass runs short and milk prices keep at their present level, it is good economy to use bran in addition to the above, the amount being proportional to the shortage of grass, up to 5 lb. per head per day when the grass gives out entirely. When cows are green soiled on maize they should get an extra pound per head of bean meal; very heavy milkers may get as much as 2 lb.

Baby beef: see rations recommended last month.

Stores at Grass should be pushed on if they are intended for beef. Those between 10 and 12 months old may get 1 lb. decorticated cotton cake and 1 lb. maize meal daily. This

ration may be doubled for stores about 15 months old. An alternative ration for the latter is 2 lb. coconut cake and 2 lb. cotton cake.

Lambs and Pigs: see rations suggested last month.

Meat Export Trade of Australia.

ON the 5th June, 1914, the Australian Government appointed a Royal Commission to enquire into the operations of any person, combination or trust tending to create any restraint of trade or monopoly in connection with the export of meat from Australia. The report of the Commissioner (Cd. 7896, price 5½*d.*) has recently been issued.

In his preliminary remarks the Commissioner refers to the general conditions under which the trade is carried on. He points out that the States place no restrictions on any person who desires to engage in the trade. The regulations are mainly confined to ensuring that exported meat is free from disease, and a certificate to this effect must be obtained from the inspector appointed for the purpose at the slaughtering establishments before the meat can be passed as fit for export. After it has been passed the meat is stamped and, unless it is in the form of preserved meat, it must be placed in a cool store kept at a temperature not exceeding 20° F. The meat must not be removed from the cold store without the authority of a departmental officer. In some States the practice is to carry out an ante-mortem examination as well as the usual post-mortem examination. The Commissioner suggests that all the States should be brought into line in this respect.

The total numbers of sheep and cattle reared in all the States in 1913 show a substantial increase over the corresponding totals for 1901. The Commissioner, however, does not consider this increase satisfactory and points out that the present production of beef, mutton, and lamb suitable for export is not commensurate with the capacity of the Commonwealth. Owing to the greater prosperity of the poorer classes in England the demand for frozen meat is increasing, and if it be found possible to proceed with the schemes for closer settlement, the Australian stock-raising industry, especially in the central and northern parts, should undergo a great expansion. Recently, a number of additional meat factories have been erected, and existing factories have been extended. The chief difficulty in Queensland has been to obtain a regular supply of cattle suitable for the export trade all the year round, but it is hoped that in time this difficulty will be overcome.

Another point to which the Commissioner called attention was the export of veal. The export of veal has recently increased

considerably, especially to the United States, and in view of the danger of an unrestricted slaughter of calves it is suggested that the matter is sufficiently serious to call for further consideration with a view to action, if necessary, of a preventative character.

The remainder of the report deals mainly with what was in effect the chief object of the enquiry, *i.e.*, to determine the effect on the Australian meat export trade of the American Beef Trust and other combinations of a similar nature. After drawing attention to the operations of these combinations in other countries the Commissioner traces in detail their operations so far as the Australian trade is concerned. The main conclusions arrived at are as follows:—

The Swift Beef Company, the Morris Beef Company, and Armour and Company, the American companies trading in the United Kingdom, which belong to the group popularly known as the American Beef Trust, have been purchasers of Australian meat, through distributing agencies abroad, for some considerable time. Together with other companies they have also made purchases for shipment to the United States.

There is nothing to indicate that these purchases were not made under ordinary competitive conditions or that there is anything in the shape of combination or concerted action on the part of these companies in Australia. The Commissioner suggests, however, that their operations should be closely followed, and recommends that for this purpose the Australian Government should invite the co-operation of the several States. The assertion is one which concerns the Imperial and Argentine Governments as well as the Australian Government, and it is suggested that a frequent interchange of communications, with a view to concerted action against any detrimental combination, should be arranged.

The Commissioner adds that it was not shown that there is any agreement among exporting firms for the purpose of suppressing competition or fixing or regulating prices.

Suggestions for Increasing the Egg Supply.

THE attention of all poultry-keepers is directed to the importance of securing as large a production of eggs as possible during the coming autumn and winter, both in order to reduce the deficiency in our supplies caused by the very restricted quantity of imported eggs, and to secure and retain the best class of trade in home markets.

It is very important that every poultry-keeper should retain the best birds for laying, and make careful selection of the birds which are to be carried over the winter.

Though the price of feeding stuffs has risen, there is no reason to assume that well selected hens and pullets will not yield an adequate return under careful management.

Preservation of Pullets.—No pullets which are capable of producing eggs in the autumn or winter should be killed. To kill such pullets is to decrease the possible food supply, and is wasteful.

Selection of Birds for Laying: Killing Old Hens, &c.—In order to maintain only those birds which are likely to be profitable, "old" hens, hens which have completed their second season, and superfluous cocks and cockerels should be sold; birds which are suffering from disease should be destroyed; and an endeavour should be made to increase the stock of pullets and young hens reserved for laying.

Management of Moulting Hens.—Special attention should be given to the management of hens during the moult. The birds should be examined carefully; they will probably moult most successfully if in slightly lean condition at the outset; birds which are too fat may be put on half rations. When the new feathers form the birds should be fed rather more liberally. The supply of green food should be abundant, and, unless they have a wide range, animal food should be added to the ration.

Use of Home-grown Produce.—Produce grown on the holding should be used as much as possible for feeding the birds; the quantity of vegetables used in the mash may be increased; feeding should be regular, but without waste of food; the ground occupied by the birds should be changed periodically, wherever it is possible; houses should be weatherproof, well lighted, well ventilated, and regularly disinfected.

The Cultivation of Seaweed in Ireland.*

AT the present time, owing to the scarcity of potash occasioned by the war, the value of seaweed in providing a source of supply of a certain amount of potash should not be overlooked. The fullest possible use should be made of all the seaweed obtainable from natural sources, and, since it can be and is artificially cultivated, the question of an extension of such cultivation deserves earnest consideration.

Seaweed contains about as much nitrogen as farmyard manure, but in a rather less valuable form, about half as much phosphates and considerably more potash.† It supplies a large quantity of organic matter, and has a special value

* *Journ. Dept. of Agric. and Tech. Instr. for Ireland*, April, 1915.

† Full particulars as to the composition and use of seaweed as a fertiliser are given in Leaflet No. 254 (*The Use of Seaweed as Manure*).

in improving the mechanical condition of the soil. In Ireland it is recommended for use in manuring potatoes, mangolds, turnips, and cabbages, and as a top-dressing for young grass or first year's "seeds." Owing to its deficiency in phosphates it should be applied along with a phosphatic manure.

The class of seaweed chiefly used for manure consists of those species, mainly of the genus Fucus and its allies, whose habitat is between high and low water marks, and which are known as "wrack." Although considerable quantities come ashore as drift, the greater portion of the supply is cut directly from the rocks and is, therefore, commonly known as "cut-weed." Cut-weed or wrack is almost exclusively used for manurial purposes.

The varieties of seaweed useful as manure all grow attached to rocks or stones and are, therefore, absent from sandy or muddy parts of the coast. They can, however, be induced to grow in such places by the provision of suitable stones to which the plants may anchor themselves. There are several places round the coast of Ireland where seaweed is cultivated in this way, and suitable localities probably exist where this practice might be extended with advantage.

At Achill the seaweed beds have been cultivated in the shallow tidal waters of the Sound, and belong to those farmers whose land fringes the coast. Large stones are collected from the shore, taken out in boats at high tide, thrown overboard and subsequently, at low water, arranged more or less regularly on the muddy or sandy bottom. The stones, of course, are covered by the sea at each incoming tide, and they soon become coated with a growth of "seedling" seaweed plants. The growth of the weed is most rapid on those stones which remain longest submerged. The crop of weed is cut once in two years, and is used as a rule by the farmer owning the bed, being but rarely sold.

At Achill Sound and at Mill Bay, in Co. Down, the weed which grows earliest and most abundantly is the "bladder-wrack" (*Fucus vesiculosus*), and this is the species most valued by farmers. Later the less esteemed *Ascophyllum nodosum* makes its appearance. In both districts the weed is used principally as a manure for potatoes, and it is placed directly in the drills in the condition in which it is cut.

The price per ton of the weed "on foot" in Ireland averaged, in 1913, about 15*s.* to 16*s.* In 1914, probably owing to the diminished area under potatoes near the beds, the price was only about 8*s.* per ton, exclusive of cutting and carting.

SUMMARY OF AGRICULTURAL EXPERIMENTS.*

SOILS AND MANURES.

Influence of Copper and Lead Salts on Wheat (*Woburn Pot Culture Experiments*, 1914; *Jour. Roy. Agric. Soc.*, 1914; *J. A. Voelcker, D.Sc.*).—The copper salts tested in 1914 were the sulphate, phosphate, carbonate, nitrate and arsenite, the amounts of copper applied to soil being ·10, ·05, ·02, ·01 and ·005 per cent. respectively in the case of each salt.

The general conclusions drawn are: (1) That copper in the form of sulphate of copper has an injurious effect when used in quantity supplying ·05 per cent. of copper or more, but that ·02 per cent. of copper, or less than this, can safely be used in this form and has a slightly stimulating effect.

(2) That copper in the form of phosphate of copper has a generally stimulating influence, and can be used in quantities supplying up to ·10 per cent. of copper without producing any toxic effect on the plant.

(3) That copper in the form of carbonate of copper is nearly as harmful as sulphate of copper, when used in quantities approaching ·10 per cent. of copper. With ·05 per cent. the effect is doubtful, but ·02 per cent., or less than this, has, when used in the form of carbonate, a stimulating influence.

(4) That copper in the form of nitrate of copper when supplying ·02 per cent. of copper or more is distinctly harmful, but when used in less amounts has a stimulating influence.

(5) That copper in the form of arsenite of copper is very harmful, and that even so small a quantity as ·05 per cent. of copper in this form may be toxic in its effects.

The salts of lead tested were the phosphate, carbonate, nitrate, sulphate, and chloride. Although the salts supplied up to ·10 per cent. of lead there was no sign of injury to the wheat, a stimulating effect being generally caused. This was especially marked with the phosphate and nitrate; with the carbonate and sulphate the results were very similar to the untreated, and with the chloride the straw seemed to be somewhat reduced.

Influence of Magnesia on Wheat and Mangolds (*Woburn Field Expts.*, 1914; *Jour. Roy. Agric. Soc.*, 1914; *J. A. Voelcker, D.Sc.*).—With wheat, in 1914, magnesia produced plants of a much darker green colour, induced more tillering and gave a more nitrogenous grain. The effect on the yield was not determined owing to the ravages of birds.

Mangolds were grown on soil which had received magnesia in 1912, no magnesia being given in 1913 or 1914. The leaves of the mangold plants were much darker in colour on the plot which had received magnesia than on the untreated plot, and an increased yield of 14 cwt. of roots per acre was obtained.

Inoculation of Crops with Peat Preparation (*Woburn Pot Culture Expts.; Jour. Roy. Agric. Soc.*, 1914; *J. A. Voelcker, D.Sc.*).—The peat preparation tested was introduced by Prof. Bottomley; with it was

* A summary of all reports on agricultural experiments and investigations recently received is given each month. The Board are anxious to obtain for inclusion copies of reports on inquiries, whether carried out by agricultural colleges, societies, or private persons.

compared heated ordinary Fen soil, the latter having given good results at Woburn in the past, in order to discover whether any results obtainable from the peat preparation might not be due purely to the organic and nitrogenous matters supplied.

The crops tested were barley, peas and mustard, and the peat preparation (one part to eight of soil) and the heated Fen soil were added to the top six inches of soil in the pots. Compared with untreated soil, the peat preparation produced crops of mustard and barley much darker in colour (the barley having a broader flag) and with peas a stronger growth and better colour. The results with peas were vitiated by blight; those from mustard and barley were as follows:—

	Mustard. Weight of green crops.		Barley.	
	1st Crop.	2nd Crop.	Corn.	Straw.
	grms.	grms.	grms.	grms.
Ordinary soil	59·6	12·3	18·1	25·5
Ordinary with peat preparation	163·3	20·6	19·6	33·5
Ordinary with heated Fen soil	71·8	20·0	14·0	27·1

With tomatoes the peat preparation was compared with nitrate of ammonia, both being applied (*a*) once, with and without phosphate of potash, (*b*) twice, with and without phosphate of potash. The nitrate of ammonia was used in such quantity as to supply the same amount of nitrogen as the soluble nitrogen in the peat preparation. During the period of growth the tomatoes treated with the peat preparation were invariably of darker green colour than the rest. The following weights of fruit were obtained:—

	Applied once, alone.	Applied twice, alone.	Applied once with phosphate of potash.	Applied twice with phosphate of potash.
	grms.	grms.	grms.	grms.
No treatment	1,114	—	—	—
Peat preparation	1,206	965	1,127	893
Nitrate of ammonia ..	1,211	1,096	1,043	1,285

MISCELLANEOUS.

The Use of Rice Flour for Bread (*Comptes Rendus des Séances de l'Académie d'Agriculture de France; Séance du 9 Juin*, 1915).—This paper did not deal with the question of whether the present or future economic situation in France would render necessary the authorisation of the addition of rice flour in making bread. The investigations described showed that the use of rice flour altered the appearance of the loaf, made its manufacture more difficult, and decreased its nutritive value, and that the only advantage to be derived was an economy which would only be felt by institutions consuming large quantities of bread.

Agricultural Returns for Ireland.

THE following Preliminary Statement, issued by the Department of Agriculture and Technical Instruction for Ireland, shows the numbers of live stock and the acreage under certain crops on 1st June, 1914, and 1st June, 1915.

TABLE I.

Table showing the numbers of certain descriptions of Live Stock in Ireland on 1st June, 1914, and 1st June, 1915.

Description of Live Stock.	Numbers on 1st June.		Increase (+) or Decrease (—).	
	1914.	1915.	Number.	Per-centage.
Horses—				
Used for Agricultural Purposes	393,646	356,460	— 37,186	— 9·4
Unbroken—				
One year old and upwards	96,790	76,680	— 20,110	—20·8
Under one year ..	55,933	53,964	— 1,969	— 3·5
Cattle—				
Bulls	32,538	32,188	— 350	— 1·1
Milch Cows	1,548,790	1,509,668	— 39,122	— 2·5
Heifers in Calf	90,139	83,359	— 6,780	— 7·5
Other Cattle—				
Two years old and upwards	1,099,645	961,861	—137,784	—12·5
One year old and under two	1,141,461	1,065,016	— 76,445	— 6·7
Under one year ..	1,139,072	1,192,293	+ 53,221	+ 4·7
Total Cattle ..	5,051,645	4,844,385	—207,260	— 4·1
Sheep—				
Breeding—				
Rams	45,970	45,941	— 29	— 0·1
Ewes	1,408,262	1,431,316	+ 23,054	+ 1·6
Other sheep—				
One year old and upwards	673,407	643,922	— 29,485	— 4·4
Under one year ..	1,472,942	1,478,340	+ 5,398	+ 0·4
Total Sheep ..	3,600,581	3,599,519	— 1,062	0·0
Pigs—				
Breeding—				
Boars	1,938	1,900	— 38	— 2·0
Sows	133,188	122,020	— 11,168	— 8·4
Other Pigs—				
Six months old and upwards..	173,816	148,516	— 25,300	—14·6
Under six months ..	996,696	932,599	— 64,097	— 6·4
Total Pigs ..	1,305,638	1,205,035	—100,603	— 7·7
Poultry—				
Total Poultry ..	26,918,749	26,041,017	—877,732	— 3·3

TABLE II.

Table showing the acreage under certain crops in Ireland on 1st June, 1914, and 1st June, 1915.

Crops.	Acreage on 1st June.		Increase (+) or Decrease (—).	
	1914.	1915.	Acreage.	Percentage.
Wheat	36,913	87,116	+50,203	+136·0
Oats	1,028,758	1,078,297	+49,539	+ 4·8
Barley	172,289	142,544	—29,745	— 17·3
Potatoes	583,069	594,801	+11,732	+ 2·0
Turnips	276,872	264,963	—11,909	— 4·3
Mangolds	81,570	84,128	+ 2,558	+ 3·1
Flax	49,253	53,233	+ 3,980	+ 8·1
Hay—				
First year	532,486	526,502	— 5,984	— 1·1
Second and Third Years	407,253	385,160	—22,095	— 5·4
Permanent Meadow ..	1,547,772	1,609,648	+61,876	+ 4·0

Agricultural Returns for Scotland.

THE Board of Agriculture for Scotland have prepared provisional estimates of the acreage of wheat, barley, oats, potatoes and hay and the numbers of each class of live stock in Scotland, based on a proportion of the returns made on 4th June last. The figures are given in the following table, with a comparison with those for 1914. It will be observed that wheat and oats show increases of 18,000 and 77,000 acres respectively while barley shows a decrease of 44,000; the total area under these three crops is thus larger by 51,000 acres. While certain classes of live stock have diminished, the total numbers of cattle, sheep and pigs show slight increases.

The usual Preliminary Statement of the Agricultural Returns will be issued when the tabulation has been completed.

Class of Stock.	Number.	Increase or Decrease as compared with 1914.	Per Cent.
Cows in Milk	361,000	— 3,000	— 0·8
Cows in Calf	43,000	— 1,000	— 2·3
Heifers in Calf	44,000	— 2,000	— 4·3
Other Cattle, 2 years and above	229,000	—13,000	— 5·4
" " 1 year to 2 years ..	299,000	+28,000	+10·3
" " under 1 year ..	252,000	+ 4,000	+ 1·6
Total of Cattle	1,228,000	+13,000	+ 1·1
Ewes for Breeding..	3,038,000	+63,000	+ 2·1
Other Sheep over 1 year	1,196,000	+29,000	+ 2·5
" " under 1 year ..	2,868,000	—16,000	— 0·5
Total of Sheep	7,102,000	+76,000	+ 1·1
Sows for Breeding	18,000	— 1,000	— 5·3
Other Pigs	140,000	+ 7,000	+ 5·3
Total of Pigs	158,000	+ 6,000	+ 3·9

Crop.	Acreage.	Increase or Decrease as compared with 1914.	Per Cent.
Wheat	79,000	+18,000	+29·5
Barley	150,000	—44,000	—22·7
Oats	997,000	+77,000	+ 8·4
Potatoes	144,000	— 8,000	— 5·2
Rye Grass, etc., for Hay	388,000	—20,000	— 4·9
Permanent Grass for Hay ..	151,000	— 6,000	— 3·8

OFFICIAL NOTICES AND CIRCULARS.

Issue of Special Leaflets.

THE purpose of the Board's Special Leaflets was explained in the note in this *Journal* for September, 1914, p. 566, and lists of those issued have been given from time to time. Since the last list given (April, 1915, p. 87), the following have been issued:—

Special Leaflet No. 5.—Fruit Preserving for Small Market Growers or for Domestic Use. (*Revised.*)
" " " 27.—The Manurial Value of Shoddy.
" " " 30.—The Use of Forage Crops for Pig Feeding.
" " " 31.—The Making of Fruit Pulp.
" " " 32.—Village War Food Societies.
" " " 33.—Suggestions for Increasing the Egg Supply.
" " " 34.—Autumn and Winter Fodder.

Maintenance of Live Stock Act, 1915.

THE Maintenance of Live Stock Act, 1915, repeals the Slaughter of Animals Act, 1914, under which the Slaughter of Animals Order of 1915 was passed, but continues the Order in force. The Maintenance of Live Stock Act will remain in force during the continuance of the present war, and for a period of twelve months thereafter, and extends the powers of the Board so as to secure the maintenance of a sufficient supply of store as well as of breeding stock.

The Board are authorised by Order to:—

(*a*) Prohibit or restrict the slaughter of animals except male lambs;

(*b*) Prohibit or restrict the sale or exposure for sale of meat of immature animals which has not been imported;

(*c*) Authorise any local authority to execute and enforce the provisions of the Order, and provide for the manner in which the expenses of the authority are to be defrayed;

(*d*) Authorise any officer of the Board or of a local authority to enter any slaughterhouse or other premises on which animals are slaughtered for human food, and examine any animals or carcasses therein;

(*e*) Prohibit or restrict the movement of animals out of any area in which the slaughter of such animals is prohibited or restricted;

(*f*) Authorise or require the marking of animals for the purpose of an Order under the Act.

Any contravention of an Order made under the Act renders the offender liable, on conviction under the Summary Jurisdiction Acts, to a fine not exceeding twenty pounds, or if the offence is in respect of more than four animals, to a fine not exceeding five pounds for each animal.

Circular Letter as to the Slaughter of Animals Order of 1915.

THE Board of Agriculture and Fisheries have issued the following circular letter, dated 6th August, 1915, to Local Authorities, with regard to the Board's Slaughter of Animals Order of 1915:—

SIR,—I am directed by the President of the Board of Agriculture and Fisheries to bring to your notice the Slaughter of Animals Order of 1915, which prohibits the slaughter of an animal which is visibly or obviously in-calf or in-pig, and to the possibility of cases occurring of a sow that comes within the scope of Article 1 of the Order being sent to a market, saleyard or lair from which, under the provisions of the Board's Orders dealing with swine-fever the sow can be moved only to a bacon factory or slaughterhouse, where it must be detained until slaughtered.

In present circumstances Lord Selborne is prepared to deal exceptionally with such cases, and, with a view of avoiding the necessity of detaining in a market, saleyard or lair, or at a bacon factory or slaughterhouse until it has farrowed, a sow that comes within the provisions of Article 1 of the Slaughter of Animals Order, he has directed that favourable consideration shall be given to any application from the owner of such a sow for a special licence authorising its removal back to the premises from which it came, or to some other suitable premises, subject to such conditions as to subsequent detention and isolation as may be considered desirable. The Board would also be prepared to consider similarly an application in any case in which a visibly or obviously in-pig sow had been moved direct to a bacon factory or slaughterhouse.

It is, the President recognises, unfortunate that it should be possible for such cases to arise, but as at present no licence is required for the removal of a pig to such premises with a view to slaughter, they are, in fact, liable to arise; and it is considered that the amendment of the Board's Order of the 27th August, 1914, in this respect, by requiring a licence to be obtained before such movement, might undesirably add to the work of the County Police.

I am, &c.,

SYDNEY OLIVIER, *Secretary.*

Committee on Land Settlement for Sailors and Soldiers.

THE President of the Board of Agriculture and Fisheries has appointed a Departmental Committee to consider and report what steps can be taken to promote the settlement or employment on the land in England and Wales of sailors and soldiers, whether disabled or otherwise, on discharge from the Navy or Army.

The Committee is constituted as follows:—

Sir Harry Verney, Bart., M.P. (*Chairman*).
The Earl of Northbrook.

The Right Hon. Henry Hobhouse.
Major-General Sir Charles Crutchley, K.C.V.O.
Mr. Sydney Mager.
Mr. Vaughan Nash, C.V.O., C.B.
Mr. F. H. Padwick.
Mr. G. H. Roberts, M.P.
Mr. Leslie Scott, K.C., M.P.

The Secretary of the Committee will be Mr. F. L. C. Floud, Assistant Secretary to the Board of Agriculture and Fisheries, to whom all communications should be sent at 4, Whitehall Place, S.W.

Agricultural Labour.

THE President of the Board of Agriculture and Fisheries desires to draw the attention of farmers to the following arrangements that have been made by the Government Departments concerned to relieve the existing shortage in Agricultural Labour.

1. Instructions have been issued to General Officers Commanding-in-Chief and to Officers Commanding District that :—

(*a*) When there is no one over recruitable age available, a working farm bailiff or foreman, a head carter, horseman, and second horseman in the case of a large farm, or waggoner, a head stockman or yardman, a shepherd, and necessary milkers (until either women, or men not of recruitable age can be trained to take their place, or other means can be provided to replace them) should not be induced to enlist.

(*b*) Sufficient engine-drivers, blacksmiths and thatchers should be left, as far as possible, in every district.

2. Instructions have been given to pension officers not to raise questions in the case of existing old age pensioners in respect of any temporary increase of means due to the pensioner's re-employment on account of shortage of labour arising out of and during the war, provided that there is no evidence of a desire to pay, on account of the pension, less than the proper rates of wages.

3. Postmen who desire to work in the harvest and who are offered employment by farmers will be granted a period of special leave for that purpose.

Agricultural Labour.

THE President of the Board of Agriculture and Fisheries has the authority of the Secretary of State for War to announce that, having regard to the valuable work for the Nation which is being done by the engine drivers and mechanics employed by the proprietors of steam ploughs and threshing machinery, it has been decided to extend the concession made in respect of the recruiting of skilled farm hands to these men, who, therefore, should not be induced to enlist.

In the event of a difference of opinion arising between Recruiting Officers and farmers or proprietors of agricultural machinery with regard to the enlistment of special men, arrangements have been made for the Chairman of each Petty Sessional Division in England and Wales to select a magistrate to act as referee in cases of the kind. Particulars of the case for reference to a magistrate must be stated on a form which will be supplied by Recruiting Officers on request.

The form, when completed, should be forwarded to the Clerk to the Petty Sessional Division concerned, who will send it to the selected magistrate and arrange a day convenient to the parties for a hearing. At the hearing only the Recruiting Officer and the employer will be permitted to attend and be heard.

Hay for His Majesty's Forces.

IN consequence of the erroneous idea which prevails in some districts that the military authorities intend to commandeer the stocks of hay in the country at whatever price they deem reasonable and without regard to the amount required for use on the farm, the President of the Board of Agriculture and Fisheries desires to make known as widely as possible the policy of the Military Authorities in respect of the acquisition of hay.

1. The Military Authorities are ready to buy at its fair market value any suitable hay which is offered to their Purchasing Officers by the grower.

2. It is not the intention to acquire hay which is proved to be wanted for the use of the stock on a farm, and instructions have been issued to Purchasing Officers not to requisition hay actually required by a farmer for the use of his animals. Should any question arise on this point it is to be referred at once to the Forage Committee, who will take immediate steps to deal with it.

3. Soft meadow hay and clear clover hay is not required as a rule for Army purposes, but should seed mixture, sainfoin, lucerne, or upland meadow hay be purchased by anyone before it has been offered to and refused by the Military Authorities, such hay will be at once requisitioned.

4. In view of the short hay crop this year, the Military Authorities have decided to reduce materially the quantity of hay purchased in this country. This should ensure an adequate supply of hay remaining for farm stock and prevent inflation of prices, and it is possible that after the lapse of a few months the Military Authorities will not be large buyers in the Home Market at all.

5. Under the Army Acts, 1879 to 1915, any difference respecting the amount of payment when hay has been requisitioned shall be determined by a County Court judge, but with the object of preventing the inconvenience which an appeal to the County Court may cause, the Army Council have appointed for England and Wales a Committee for the Northern Area and one for the Southern Area for the purpose of hearing the views of the owner on the value of the hay requisitioned from him and the views of the District Purchasing Officer on the same. The Committee in each case will give their opinion on the price which should be paid for the hay in question, and this opinion the War Office will accept; but if the owner of the hay is dissatisfied with the opinion of the Committee which has considered his case it is still open to him to apply to the County Court judge.

6. Each Committee will consist of three members: (1) a farmer selected from one of the Farm Produce County Committees of the area concerned; (2) a hay merchant, and (3) an officer from the Purchasing Establishment of the War Office. The Secretary to each Committee is Lieutenant C. B. Rolfe, 64, Whitehall Court, London, S.W.

THE Board of Trade (Labour Exchange Department) have issued the following notes on war service for country women :—

War Service for Country Women.

(*a*) *For Organisers.*—There is a great deal of patriotism and energy and capacity for work running to waste among our village women at present for lack of a little organisation.

Women and girls living at home are longing to do their part in this great crisis; farmers are at their wits end to find enough labour to get in their crops; and neither seems to think of the other as the obvious solution of their difficulty. Something is being done in some places by importing trained whole-time women to work on the farms; but the large supply of part-time workers on the spot is not being fully utilised.

There seems no reason, however, why all those willing and able to give a part of their time to farm work should not be enrolled on a register kept in each village, and be set to work on farms close to their homes, as they are wanted.

An informal meeting of all the women of all classes in the village should be held, and the plan explained, with plenty of discussion, both to the future workers, and to the wives of those likely to employ them. Somebody, preferably a woman, but in any case someone well known in the village, and popular, and living in a central position, should be chosen to keep this register, which need only be a copybook with its pages divided into columns for the worker's name and address, age, kind of work wanted, special qualifications, amount of free time, and lastly, the name of whoever engaged her.

At that same meeting the register could be made; those present would be asked what they would and could do, and their names, etc., could be entered at once in the book. No serious offer of help of any kind should be refused. The real object is to awaken the spirit of co-operation in doing the men's work of food production during their absence; and very often the practical labourer's wife will make most useful suggestions; for instance, one Somerset woman who could not leave home at all, volunteered to wash and mend all the milking overalls to relieve the overworked farmer's wife; and another, too delicate for farm work of any sort, volunteered to mind the small children of those fit for outdoor work. Both were at once entered on the register.

The keeper of the register should be in touch with the nearest Labour Exchange, so that her address may be given to both employers and employees applying to the Exchange from her neighbourhood. She could also be of great assistance by keeping a list of houses and cottages where imported whole-time women workers could be suitably lodged.

It is important that, wherever a register is started, the fact should be made known as widely as possible. An account of the meeting should be sent to the local paper, giving the name and address of the keeper of the register; those present at the meeting should be asked to tell those who were not there about it; a notice of the register, with the name and address of the registrar, can be put up in the post office and shop, and, most important of all, those who are willing to do farm work should *train* themselves for it ostentatiously. If, for instance, women and girls of high standing socially, who live in a dairying district, will at once learn to milk, and will let the other inhabitants see them going, in suitable working dress, to and from their work, day after day,

then their social inferiors will not be slow to follow their example, and the employers of labour will take them seriously. It is a good plan, too, for the women on the register to start growing vegetables on any unused bit of allotment or cottage garden; apart from the produce, it is proof that they are able as well as willing to dig and hoe and do any other garden work wanted from them.

It should be made plain from the first that all this War work should be paid for at a fair rate. Food is a most important part of our soldier's equipment. Once the possibility of a scarcity of food is realised by the women in our villages, they will be as keen to work on the farms at providing food, as the town women are to work in factories at providing munitions.

"Every woman who by working helps to release a man or to equip a man, for fighting, does National War Service."

(*b*) *For Workers.*—There are thousands of women and girls in our villages who are longing to do their bit of War work but who are unable to leave home to do so.

It seems obvious that for those who live in the country in this time of high prices for food, the right kind of War work is to help in every way practicable to produce and harvest as much food as possible. Without extra help from women there will be less instead of more food harvested this summer, because so many of our best men have joined the Army.

Most of us who live in the country have some spare time during the day, and with a little management we could make more. This might all be given to help in farm and garden work. Some of us could go milking once or twice a day; some of us could get all our usual work finished in the morning and help in hay or harvest field for the rest of the day; nearly all of us could help in picking fruit, both wild and garden varieties, for jam, and in making as much jam as possible this year; some of us could go out weeding and hoeing for the farmers; many of us could start keeping fowls or take more pains with the fowls we have already got, so that they shall be more productive; all of us can see to it that no ground is wasted in our own gardens that might be used for growing more vegetables for use in the winter. So let the farmers round about know that you are ready and willing to help them in any way you can; learn to milk at once; learn all you can about dairy work; let your neighbours know that you are ready to help them; it may be that War work for you will be in minding the children next door or in taking them all to pick blackberries while their mother works in the hayfield, because all the farmers' men have joined the Army.

In some places a register is being kept of all the women willing to do War service of any kind, so that farmers in need of help may be able to find out at once who is willing to give it. If such a register is being kept in your village, put your name down on it at once for whatever work you think you can best do; if not put your name down at the nearest Labour Exchange. All work done for the farmers will be paid for at a fair rate.

If you know of an allotment or bit of garden that is not being used, try and get it for growing more vegetables for your own use, or for sale during the coming winter.

If the War continues, a plentiful food supply will be all-important. All women who work to provide this are among those who " by working help to equip a man or to release a man for fighting ; and are doing National War Service."

War Service for Women.

THE Labour Exchange Department of the Board of Trade have issued the following notes on agricultural work and training for women.

Women are needed for agricultural work, especially in the following branches :—

(1) Milking and dairy work.
(2) Care of cattle, pigs and poultry.
(3) Field and market garden work, *e.g.*, potato planting, weeding, thinning, hop-tying.

For milking and dairy work a course of training is necessary if the worker is to be in a position to command nearly full wages from the commencement. In the other branches useful work of some value from the wage-earning point of view can be rendered from the beginning, and experience may be rapidly acquired as a result of working under supervision for a short time.

The necessary training in milking and dairy work may be given by farmers who intend to employ the trained women on their own farms. It is impossible to forecast what vacancies of this nature may be notified to the Labour Exchanges from time to time, so that no general statement can be made as to the districts in which such openings may occur, or as to what arrangement may be made in regard to wages.

There are a few agricultural colleges and a limited number of private farms where a short course of training can be obtained on payment of a fee. The cost is usually about £1 per week for instruction, board and lodging.

In many counties there are travelling dairy schools which provide short courses of instruction, usually extending over about ten days, while a few County Education Authorities are now arranging special short courses of training with a view to preparing women for light farm work. Information in regard to these schools and courses can be obtained from the County Education Secretaries.

The Board of Agriculture and Fisheries have arranged for a strictly limited number of courses of training extending over two to four weeks, to be given at certain Agricultural Colleges. In these courses maintenance is provided and no cost is involved for the women under training. The courses are provided at present in Kent, Hampshire, Derby, Yorkshire, Cardiganshire, and Shropshire and will be provided at a later date in Carnarvonshire and Cumberland. The college authorities prefer to take students from their own county.

The Board of Agriculture and Fisheries have stated that 12s. to 15s. a week may be considered an average wage for women in agricultural work under present conditions. It is not possible to make any further general statement as to wages, housing, or other conditions, but full details will be given in connection with individual vacancies notified to the Labour Exchanges.

Applicants for agricultural work, however, should realise that the hours are necessarily long, and certain parts of the work must be done in the early hours of the morning and on Sundays.

A strong physique is essential.

Any woman who desires to obtain agricultural training should register her name and address at the Labour Exchange in the district in which she resides (the address of which can be obtained at the nearest Post Office) and inform the officer in charge what fees, if any, she is prepared to pay, and what work she feels best able to do. Her name will then be considered in connection with any suitable openings that may be notified to the Labour Exchange Department.

MISCELLANEOUS NOTES.

The Decline in the Agricultural Area of England and Wales.*

OF the 37,139,153 acres which, according to the latest measurements of the Ordnance Survey, make up the total area of England and Wales, 27,114,004 acres were returned as under crops and grass on the 4th June, 1914. This is 15,378 acres less than in 1913, and the smallest total returned in any year since 1877. This decline may be attributed in the main to the increase in the urban area, and to the constantly expanding demand for land for industrial purposes, which has been a normal feature since 1891. A noticeable point, however, is that the rate of decrease has been on this occasion greatly slackened: the average annual decrease between 1891 and 1913 having been very nearly 40,000 acres, and, except for 1906, when the decrease was only 12,000 acres, the present decline of 15,000 acres is the smallest that has been noted since the agricultural area first began to fall 22 years ago. The decline was general throughout the country, except in the west and south-west of England, where there was a small increase.

In addition to the area strictly under crops or grass, there are two other categories of land of an agricultural character, namely woodlands, and mountain or heath land which, while the herbage is too sparse or of too poor a quality to be regarded as pasture, is nevertheless utilised for grazing. This latter area was returned in 1914 as 3,781,565 acres, or some 23,500 acres less than in 1913. The inquiry as to the acreage of woodlands was not repeated in 1914; but, assuming that the figure of 1,884,068 acres returned in 1913 has remained practically constant, it would appear that 32,779,637 acres, or 88 per cent. of the total area of England and Wales, is either under cultivation, grazed, or woodland.

Short Course in Poultry Management.

A FOUR weeks' course on Practical Management of Poultry will be held at the South Eastern Agricultural College, Wye, Kent, commencing 1st September, 1915. The course is open to men and women—Fee, £3.

Residential accommodation can be obtained in Wye, close to the College, Farm and Gardens. Use may be made of the Horticultural Department of the College if those attending the course require instruction in Fruit and Vegetable Growing. For particulars, etc., application should be made to the Secretary.

* Agricultural Statistics, 1914, Part I.: Acreage and Live Stock Returns of England and Wales [Cd. 7926]. Price 6d.

Notes on Agriculture Abroad.

Establishment of a Plant Diseases Branch of the French Ministry of Agriculture.—By a Decree of 11th May, 1915, the French Ministry of Agriculture has established a branch for the study of plant diseases. The object of the Decree is to co-ordinate the work of the services and institutions already controlled by the Ministry of Agriculture, rather than to establish an entirely fresh department. The new service will comprise a number of stations already existing for the study of plant diseases, the phytopathological inspectors for agriculture and horticulture and the service for the control of imported seeds of forage plants. The Decree fixes the numbers and rates of remuneration of the inspectors and other officials, and provides for the employment of temporary assistance as well as the payment of grants to institutions and individuals for special research into plant diseases.

The establishment of the Phytopathological Service for the inspection of nurseries for the purpose of granting export certificates for horticultural produce was noted in this *Journal* for September, 1911, p. 516, and April, 1913, p. 75; by a Decree of 5th February, 1915, the operations of this Service were extended to include agricultural produce; the whole service is now, as stated, comprised in this new branch of the Ministry of Agriculture.—(*Bull. Mens. de l'Office de Renseignements Agricoles*, January–May, 1915.)

Inoculation of Cattle in Rhodesia against the Plasmoses.—The indigenous cattle of Rhodesia are small and slow to mature, and these defects can only be remedied by mating with bulls of improved types. It has been estimated by the Chief of the Animal Industries Branch of the Rhodesian Agricultural Department that at the present time 500 stud bulls are urgently required for this purpose. The mortality of cattle introduced from oversea has, however, been so great as to render importation an extremely hazardous and costly proceeding.

It appears that, under existing conditions in Rhodesia, the ideal method of dealing with piroplasmosis and anaplasmosis is to supplement regular dipping with a simple and safe method of protective inoculation. To obtain such a method, a series of experiments was conducted on twelve shorthorn heifers imported from Great Britain. No success was obtained in the direction of the discovery of a specific therapeutic agent against anaplasmosis, comparable in effect to trypan blue in the treatment of piroplasmosis; but a very favourable virus was obtained, and six of the experimental animals upon which it was used suffered from mild reactions from which they recovered. These heifers are now being exposed to natural tick infection, which it is confidently believed they will resist. This virus and modifications of it are now being tested on the remainder of the consignment, and, if the favourable results are continued, it is hoped that within the near future the inoculation of imported stock may be undertaken with better results than hitherto. (*Rhodesia Agricultural Journal*, June, 1915).

Notes on Crop Prospects Abroad.

THE *Bulletin of Agricultural and Commercial Statistics* for July, 1915, issued by the International Institute of Agriculture, contains the following estimates of the production of cereal crops:—*Wheat*—England and Wales, 7,836,000 qr. in 1914-15 against 7,305,000 qr. in 1913-14; Italy, 23,877,000 qr., against 21,174,000 qr.; Russia in Europe (54 governments), winter, 37,678,000

qr., against 26,851,000 qr.; spring, 57,916,000 qr., against 44,791,000 qr.; Switzerland, 488,000 qr., against 410,000 qr.; United States, winter, 83,478,000 qr., against 85,601,000 qr.; spring, 36,865,000 qr., against 25,747,000 qr.; India, 47,908,000 qr., against 38,950,000 qr.; Japan, 2,958,000 qr., against 2,704,000 qr. *Rye*—Italy, 551,000 qr., against 613,000 qr.; Russia in Europe (54 governments), winter, 109,837,000 qr., against 91,836,000 qr.; spring, 846,000 qr., against 660,000 qr.; Switzerland, 246,000 qr., against 201,000 qr. *Barley*—England and Wales, 5,272,000 qr., against 6,172,000 qr.; Italy, 1,102,000 qr., against 830,000 qr.; Russia in Europe (54 governments), 59,014,000 qr., against 45,095,000 qr.; Switzerland, 72,000 qr., against 63,000 qr.; United States, 24,952,000 qr., against 23,387,000 qr.; Japan, 11,698,000 qr., against 10,960,000 qr. *Oats*—England and Wales, 9,098,000 qr., against 9,551,000 qr.; Italy, 3,179,000 qr., against 2,751,000 qr.; Russia in Europe (54 governments), 98,334,000 qr., against 74,084,000 qr.; Switzerland, 565,000 qr., against 533,000 qr.; United States, 143,447,000 qr., against 116,999,000 qr. *Maize*—The production in the United States in 1915 is estimated at 328,205,000 qr., against 311,737,000 qr. in 1914, an increase of 5·3 per cent.

France.—The condition of winter oats on 1st July was officially estimated at 71 as compared with 67 in 1914; of spring oats 68 against 71; of winter barley 73 against 74; and spring barley 69 against 70. (80 = good, and 60 = fairly good). (*Broomhall's Corn Trade News*, 24th July.)

Holland.—H.B.M. Consul-General at Rotterdam, in a report relating to agricultural conditions on the 14th July, stated that rye and potatoes would probably yield rather unfavourably. Beans were generally fairly good to good, and peas mostly fairly good, while onions and sugar beet were good. The spring-sown corn crops had suffered from the drought, particularly oats. The areas under the crops were as follows:—Wheat 160,093 acres, as compared with 148,279 acres in 1914; rye, 548,728 acres, against 562,355 acres; barley, 63,146 acres, against 66,633 acres; oats, 350,382 acres, against 348,065 acres; horsebeans, &c., 38,925 acres, against 39,895 acres; under peas, 61,046 acres, against 64,788 acres; eating potatoes, 344,130 acres, against 346,501 acres; factory potatoes, 80,100 acres, against 77,136 acres; sugar beet, 141,012 acres, against 156,188 acres; onions, 7,556 acres, against 6,904 acres; and red clover, 68,167 acres, as compared with 72,371 acres in 1914.

Russia.—H.M. Commercial Attaché, Petrograd, stated that, according to the official "Trade Gazette" of Petrograd of the 26th June, the total area under sugar-beet on the 14th June was 1,895,834 acres as compared with 2,100,292 acres in 1914. The condition of the sowings in general was considered satisfactory, 38·8 per cent. being good, 38·6 per cent. being satisfactory, 14·6 per cent. unsatisfactory, and 6·08 per cent. bad.

Canada.—According to a bulletin dated 11th June, issued by the Census and Statistics Office at Ottawa, indications pointed to an increase in the yield per acre of 15·6 per cent. for winter wheat, of 2·6 per cent. for spring wheat, and of 2·5 per cent. for rye, but to a

decrease of 1·5 per cent. for oats and 0·7 per cent. for barley, as compared with the average of the years 1910–1914.

United States.—The Crop Reporting Board of the Bureau of Statistics of the Department of Agriculture, in reporting as to crop conditions on the 1st August, states that the total production of winter wheat is estimated at 659,000,000 bush. as compared with a yield of 684,990,000 bush. last year; spring wheat at 307,000,000 bush. against 206,027,000 bush.; maize, 2,918,000,000 bush. against 2,672,804,000 bush.; oats, 1,402,000,000 bush. against 1,141,060,000 bush.; barley, 217,000,000 bush. against 194,953,000 bush.; rye, 44,000,000 bush. against 42,779,000 bush.; and linseed, 18,000,000 bush. against 15,559,000 bush.—(*The London Grain, Seed and Oil Reporter*, 9th August.)

Live Stock in France.—According to the census of cattle and sheep taken by the Ministry of Agriculture, the total number of cattle on 1st July was 12,286,849, compared with a total of 13,120,649 on 31st December, 1914, and the total number of sheep was 12,483,189, a decrease of 1,321,121, or about 10 per cent. (*London Grain, Seed and Oil Reporter*, 22nd July.)

Live Stock in Denmark.—The live stock statistics collected on the 15th May, 1915, place the number of horses at 525,690, compared with 567,240 on the 15th July, 1914, a decrease of 7·3 per cent.; of cattle at 2,416,471, against 2,462,862, a decrease of 1·9 per cent.; of sheep at 533,034, against 514,908, an increase of 3·5 per cent.; and of pigs at 1,918,627, against 2,496,706, a decrease of 23·2 per cent. (*Bulletin of Agricultural and Commercial Statistics*, July, 1915.)

Live Stock in India.—The numbers of live stock in British India (excluding Bengal) are as follows:—Bulls and bullocks, 47,002,902 in 1912-13, against 37,085,104 in 1911-12, an increase of 26·7 per cent.; cows, 35,711,694, against 28,067,259, an increase of 27·2 per cent.; buffaloes: bulls, 5,235,503, against 4,659,775, an increase of 12·4 per cent.; cows, 12,471,983, against 12,091,450, an increase of 3·1 per cent.; young stock (calves and buffalo calves), 38,639,837, against 29,810,602, an increase of 29·6 per cent.; sheep, 22,934,265, against 22,848,043, an increase of 0·4 per cent.; goats, 28,683,583, against 28,554,832, an increase of 0·5 per cent.; horses and ponies, 1,554,830, against 1,539,945, an increase of 1·0 per cent. (*Bulletin of Agricultural and Commercial Statistics*, July, 1915.)

Agricultural Labour in England and Wales during July.

ACCORDING to statements in the Board's *Monthly Agricultural Report* for 1st August, the supply of labour was everywhere scarce, though farmers rarely fell behind-hand, except with turnip-hoeing, which was in many places much in arrears. In hop districts, the constant labour necessitated by the blight in the hop-yards contributed to delay in getting in the hay. Generally, the light hay crop helped the situation, but a good deal of apprehension was expressed regarding the corn harvest, as the demand for temporary labour will be increased by the fact that so much of the crop has been laid.

The following local summaries give further details regarding agricultural labour in the different districts of England and Wales:—

Northumberland, Durham, Cumberland, and Westmorland.—There was a general deficiency of labour especially for turnip-hoeing and hay-making; but the light hay crops prevented the difficulty from becoming acute.

Lancashire and Cheshire.—Labour was rather short, but there was no serious hindrance to farm work

Yorkshire.—Labour was very scarce and temporary labourers for turnip-hoeing and hay-making were difficult to get, but the position was saved by the character of the weather and the light hay crop.

Shropshire and Stafford.—Labour was scarce throughout the division.

Derby, Nottingham, Leicester, and Rutland.—Labour was still generally deficient. In some districts women and boys supplied temporary needs.

Lincoln and Norfolk.—Though there was a shortage of labour in some districts the deficiency did not, on the whole, cause serious trouble.

Suffolk, Cambridge, and Huntingdon.—The deficiency in the supply of labour seemed general throughout the division, and fears were expressed as to the prospects for harvest, especially if unsettled weather continues. In some localities more wages will be demanded for harvest labour; but so far wages do not seem to have risen generally.

Bedford, Northampton, and Warwick.—The supply of labour was short in most districts, especially in Bedford. The prospect of obtaining casual labour for the harvest was bad.

Buckingham, Oxford, and Berkshire.—Labour was generally deficient, and casual labour especially was difficult to obtain.

Worcester, Hereford, and Gloucester.—Labour was generally deficient, especially for turnip-hoeing and for cutting laid corn.

Cornwall, Devon, and Somerset.—The supply of labour was short, particularly casual labour for hoeing, &c.

Dorset, Wiltshire, and Hampshire.—The supply of labour was deficient, skilled ploughmen and milkers being particularly in demand. On some farms it was difficult to obtain labour for hoeing root crops.

Surrey, Kent, and Sussex.—On the whole there was a shortage of labour, but in some districts women had been helping with the hay harvest. The chief shortage had been experienced with hoeing, and some difficulty was expected with the harvest where the corn was beaten down. In spite of the shortage of labour the work on farms was generally well kept up.

Essex, Hertford, and Middlesex.—Labour was generally deficient, but farmers were managing. Prospects were less encouraging, as the effect of the storms, by laying the crops, was to increase the demand for harvest labour.

North Wales.—A general scarcity was reported from some districts. In others the supply of regular labour was sufficient, while temporary labour was scarce. The general supply of labour was better than was anticipated, and rates of wages for extra labour were lower than was expected.

Mid-Wales.—Labour in most places was rather short, but operations were not seriously hindered. In the south of Montgomery soldiers had been helping with the hay, and labour was abundant.

South Wales.—There was some general shortage of labour. In Glamorgan good reliable farm hands were in demand, but casual labour

was plentiful. In Carmarthen the supply of casual labour was reported to be deficient. In some districts slight increases in wages were made, especially for piecework or overtime.

Agricultural Conditions in England and Wales on 1st August.

THE Crop Reporters of the Board, in reporting on agricultural conditions in England and Wales on the 1st August state that the somewhat heavy rainfall of July was, upon the whole, beneficial to crops generally, which had suffered from too long a period of dry weather. Corn, roots, and pastures all show considerable improvement; on the other hand a good deal of corn has been laid by heavy storms, beans have deteriorated, and meadow hay has been damaged. Warm and sunny weather is now universally required.

Wheat shows a slight improvement, and the yield should prove nearly average. Harvesting—which should soon commence generally—will be rendered difficult in many districts, as many fields, especially the heavier crops, have been laid by storms. Barley and oats have very considerably improved during the month, although both are still well under average. A fair amount of winter oats has already been cut. Straw is still rather short. Beans have suffered from the weather, and there has been much blight; they have gone back on the month. The effect of the weather on peas has been variable, and, on balance, prospects remain about the same as on 1st July.

Potatoes have been much improved by the rain. Early varieties are rather light, but the main crop is more satisfactory, and the ultimate yield, on present appearances, should be about average. A little disease is reported as showing itself in several parts of the country.

Turnips and swedes have now got a good start since the rains. Much fly appeared during the dry weather, and a good deal of re-sowing has been necessary. Reports are, however, very variable; the crop is everywhere late, and fields are often patchy. In many districts the present condition as regards health and vigour is an average one, but elsewhere prospects are less promising. Mangolds have improved during the month, and the crop should ultimately fall not very much below the normal.

The seeds hay, which is a light crop, was mostly secured in good condition, at least in the southern part of the country, before the rain set in. But the change in the weather brought a check to hay-making, so that late crops of seeds, and the bulk of the meadow hay have been a good deal damaged, while hay-making has been much protracted. While the total yield of seeds hay is now considered to be very slightly greater than a month ago, there is no improvement noted in meadow hay, the extra growth induced by the rain being probably balanced by the damage caused by the heavy storms. The strawberry crop has proved below average on the whole, although several districts have been favoured with large crops. Other small fruit crops have been about average: raspberries rather more, currants and gooseberries rather less. Apples are expected to be below average, but better in the west and midlands than in the east and south; pears are generally abundant, while cherries and plums are rather below average on the whole. But with all kinds of fruit there is very considerable diversity in different parts of the country.

Prospects for hops have greatly deteriorated during the month. The rain was much needed to encourage growth of the bine, but the cold nights have counteracted this; and the heavy storms have done a good deal of damage without diminishing the blight. Hops have experienced one of the worst attacks of aphis for thirty years, which has greatly weakened the plants, in spite of continual washing. Red spider is reported also to have done damage in the south-eastern districts. On the whole, it is considered that Worcester and Hereford will not have more than half a crop, while the Kent and Sussex districts will be from 30 to 35 per cent. below average.

Pastures have been greatly improved by the rain. Keep is plentiful everywhere, with rare exceptions, and even there the grass is recovering. Live stock are consequently doing very well.

Summarising the returns, and expressing an average crop by 100, the condition of the crops on 1st August indicated probable yields which may be denoted by the following percentages:—Wheat, 99; barley, 93; oats, 92; beans, 96; peas, 95; potatoes, 100; mangolds, 98; seeds hay, 90; meadow hay, 79; hops, 64.

Prevalence of Animal Diseases on the Continent.

The following statement shows that according to the information in the possession of the Board on 1st August, 1915, certain diseases of animals existed in the countries specified:—

Austria (*on the 14th July*).
Foot-and-Mouth Disease, Glanders and Farcy, Swine Erysipelas, Swine Fever.

Denmark (*month of June*).
Anthrax, Foot-and-Mouth Disease (1,201 outbreaks), Glanders and Farcy, Swine Erysipelas, Swine Fever.

France (*for the period 4th—17th July*).
Foot-and-Mouth Disease, Glanders and Farcy, Sheep-pox.

Germany (*for the period 1st—15th July*).
Foot-and-Mouth Disease, Glanders and Farcy, Swine Fever.

Holland (*month of June*).
Anthrax, Foot-and-Mouth Disease (186 outbreaks), Foot-rot, Glanders, Swine Erysipelas.

Hungary (*on the 14th July*).
Foot-and-Mouth Disease, Glanders and Farcy, Swine Erysipelas, Swine Fever.

Italy (*for the period 12th—18th July*).
Anthrax, Blackleg, Foot-and-Mouth Disease (226 outbreaks), Glanders and Farcy, Rabies, Sheep-scab, Swine Fever, Tuberculosis.

Norway (*month of June*).
Anthrax, Blackleg, Swine Fever.

Rumania (*for the period 21st—29th June*).
Anthrax, Foot-and-Mouth Disease, Glanders and Farcy, Rabies, Sheep-pox, Swine Erysipelas, Swine Fever.

Russia (*month of March*).
Anthrax, Foot-and-Mouth Disease (50,278 animals), Glanders and Farcy, Pleuro-pneumonia, Rabies, Sheep-pox, Swine Erysipelas, Swine Fever.

Spain (month of May).

Anthrax, Dourine, Glanders, Pleuro-pneumonia, Rabies, Sheep-pox, Sheep-scab, Swine Erysipelas, Tuberculosis.

Sweden (month of June).

Anthrax, Blackleg, Foot-and-Mouth Disease (3 outbreaks), Swine Fever.

Switzerland(for the period 19th—25th July).

Anthrax, Blackleg, Foot-and-Mouth Disease (26 "étables" entailing 3,712 animals, of which 7 "étables" were declared infected during the period), Glanders, Swine Fever.

No further returns have been received in respect of the following countries:—Belgium, Bulgaria, Montenegro, Serbia.

The Weather in England during July.

District.	Temperature.		Rainfall.				Bright Sunshine.	
	Daily Mean.	Diff. from Average.	Amount.		Diff. from Average.	No. of Days with Rain.	Daily Mean.	Diff. from Average.
Week ending July 10th:	°F.	°F.	In.	Mm.*	Mm.*		Hours.	Hours
England, N.E. ...	58·3	—0·3	1·54	39	+27	4	5·1	—1·6
England, E.	61·7	+1·2	0·94	24	+13	4	6·1	—1·3
Midland Counties ...	58·8	—1·1	1·57	40	+28	4	4·9	—1·8
England, S.E.... ...	61·6	+0·6	0·67	17	+ 7	3	6·3	—1·4
England, N.W. ...	57·6	—1·1	0·98	25	+10	3	5·2	—1·2
England, S.W. ...	58·7	—0·7	1·12	29	+16	3	5·9	—1·1
English Channel ...	60·4	—0·2	0·42	11	0	2	9·7	+1·2
Week ending July 17th:								
England, N.E.... ...	55·5	—3·3	1·19	30	+18	5	4·9	—1·5
England, E.	57·3	—3·4	1·42	36	+23	5	4·5	—2·6
Midland Counties ...	55·9	—4·2	1·47	37	+24	4	4·6	—1·7
England, S.E.... ...	57·3	—4·2	1·30	33	+21	4	4·1	—3·3
England, N.W. ...	56·2	—2·7	0·73	19	+ 3	4	5·4	—0·8
England, S.W. ...	56·5	—3·3	1·53	39	+23	4	5·9	—0·8
English Channel ...	57·9	—3·3	1·33	34	+21	4	5·4	—2·7
Week ending July 24th:								
England, N.E. ...	58·7	0·0	0·54	14	0	4	4·8	—1·4
England, E.	59·3	—1·4	1·09	28	+13	5	5·6	—1·0
Midland Counties ...	58·3	—1·8	0·88	22	+ 7	5	4·3	—1·5
England, S.E	58·7	—2·9	1·11	28	+14	4	6·1	—0·7
England, N.W. ...	57·8	—1·2	0·61	16	— 2	4	4·7	—1·0
England, S.W. ...	57·8	—2·2	1·38	35	+16	5	5·4	—0·8
English Channel ...	59·4	—2·1	1·06	27	+13	2	8·0	+0·5
Week ending July 31st:								
England, N.E. ...	56·3	—2·4	0·42	11	— 6	4	8·1	+2·5
England, E.	58·4	—2·3	0·61	15	+ 1	4	8·0	+1·8
Midland Counties ...	56·4	—3·6	0·53	14	— 2	4	7·7	+2.2
England, S.E.... ...	58·3	—3·3	0·45	11	— 3	3	9·1	+2·7
England, N.W. ...	56·5	—2·5	0·63	16	— 4	4	8·2	+2.7
England, S.W. ...	56·8	—3·2	0·73	19	0	4	7·5	+1·6
English Channel ...	58·6	—3·0	0·69	17	+ 3	4	8·7	+1·3

* 1 inch = 25·4 millimetres.

DISEASES OF ANIMALS ACTS, 1894 to 1914.

NUMBER OF OUTBREAKS, and of ANIMALS Attacked or Slaughtered.

GREAT BRITAIN.

(*From the Returns of the Board of Agriculture and Fisheries.*)

DISEASE.	JULY.		SEVEN MONTHS ENDED JULY.	
	1915.	1914.	1915.	1914.
Anthrax:—				
Outbreaks	35	41	393	482
Animals attacked	50	51	451	522
Foot-and-Mouth Disease:—				
Outbreaks	—	—	—	11
Animals attacked	—	—	—	74
Glanders (including Farcy):—				
Outbreaks	7	15	32	68
Animals attacked	20	70	59	212
Parasitic Mange:—				
Outbreaks	124	123	*535	1,503
Animals attacked	271	157	*1,171	2,613
Sheep-Scab:—				
Outbreaks	3	3	159	150
Swine Fever:—				
Outbreaks	415	411	2,747	2,599
Swine Slaughtered as diseased or exposed to infection ...	1,583	4,947	12,360	27,518

* Figures for four months only, the Parasitic Mange Order of 1911 having been suspended from 6th August, 1914, to 27th March, 1915, inclusive.

IRELAND.

(*From the Returns of the Department of Agriculture and Technical Instruction for Ireland.*)

DISEASE.	JULY.		SEVEN MONTHS ENDED JULY.	
	1915.	1914.	1915.	1914.
Anthrax:—				
Outbreaks	—	—	1	1
Animals attacked	—	—	1	1
Foot-and-Mouth Disease:—				
Outbreaks	—	1	—	76
Animals attacked	—	2	—	957
Glanders (including Farcy):—				
Outbreaks	—	—	1	—
Animals attacked	—	—	3	—
Parasitic Mange:—				
Outbreaks	8	6	44	55
Sheep-Scab:—				
Outbreaks	14	28	268	375
Swine Fever:—				
Outbreaks	22	26	162	142
Swine Slaughtered as diseased or exposed to infection ...	87	69	910	712

PRICES OF AGRICULTURAL PRODUCE.

AVERAGE PRICES of LIVE STOCK in ENGLAND and WALES in July and June, 1915.

(Compiled from Reports received from the Board's Market Reporters.)

Description.	JULY.		JUNE.	
	First Quality.	Second Quality.	First Quality.	Second Quality.
FAT STOCK :—	per stone.*	per stone.*	per stone.*	per stone.*
Cattle :—	*s. d.*	*s. d.*	*s. d.*	*s. d.*
Polled Scots	13 4	12 4	13 6	12 5
Herefords	13 4	12 0	13 2	11 10
Shorthorns	13 2	12 1	13 1	11 11
Devons	13 4	12 0	13 2	12 0
Welsh Runts	13 3	12 7	12 11	12 3
	per lb.*	per lb.*	per lb.*	per lb.*
	d.	*d.*	*d.*	*d.*
Veal Calves	10¾	9¾	10¾	9¾
Sheep :—				
Downs	11	10	11	10
Longwools	10½	9¼	10½	9¼
Cheviots	11¼	10	11¾	10¾
Blackfaced	10¼	9¼	11	10
Welsh	10¼	9¼	11	10
Cross-breds	10¾	10	11¼	10¼
	per stone.*	per stone.*	per stone.*	per stone.*
Pigs :—	*s. d.*	*s. d.*	*s. d.*	*s. d.*
Bacon Pigs	9 7	9 0	9 4	8 9
Porkers	9 11	9 5	9 8	9 2
LEAN STOCK :—	per head.	per head.	per head.	per head.
Milking Cows :—	£ *s.*	£ *s.*	£ *s.*	£ *s.*
Shorthorns—In Milk ...	26 6	21 10	25 12	20 18
,, —Calvers ...	24 12	20 13	24 15	20 12
Other Breeds—In Milk ...	24 3	19 9	24 1	18 19
,, —Calvers ...	18 0	16 10	18 10	17 10
Calves for Rearing	3 5	2 10	3 6	2 14
Store Cattle :—				
Shorthorns—Yearlings ...	13 9	11 5	13 15	11 15
,, —Two-year-olds...	18 9	16 2	18 7	16 2
,, —Three-year-olds	23 19	20 18	23 3	19 15
Herefords —Two-year-olds...	21 0	17 5	20 1	17 0
Devons— ,,	18 10	16 8	21 6	18 1
Welsh Runts— ,,	17 10	16 18	16 18	15 18
Store Sheep :—				
Hoggs, Hoggets, Tegs, and Lambs—	*s. d.*	*s. d.*	*s. d.*	*s. d.*
Downs or Longwools ...	44 1	36 8	54 10	45 8
Store Pigs :—				
8 to 12 weeks old	26 11	21 1	26 3	20 7
12 to 16 weeks old	41 5	32 1	41 0	32 8

* Estimated carcass weight.

AVERAGE PRICES of DEAD MEAT at certain MARKETS in ENGLAND in July, 1915.

(Compiled from Reports received from the Board's Market Reporters.)

Description.	Quality.	Birmingham.	Leeds.	Liverpool.	London.	Manchester.
		per cwt.	per cwt.	per cwt.	per cwt.	per cwt.
		s. d.	s. d.	s. d.	s. d.	s. d.
BEEF:—						
English	1st	88 6	86 6	—	88 6	84 6
	2nd	84 0	83 6	—	83 6	80 6
Cow and Bull	1st	78 6	79 6	76 0	76 6	76 6
	2nd	74 0	72 6	70 6	71 6	70 0
Irish: Port Killed	1st	85 0	83 0	83 0	85 0	81 0
	2nd	81 6	78 0	78 0	80 6	76 0
Argentine Frozen—						
Hind Quarters	1st	78 0	78 0	78 0	77 6	78 0
Fore ,, ...	1st	70 0	72 6	69 0	67 0	69 0
Argentine Chilled—						
Hind Quarters	1st	82 0	79 6	81 6	81 6	81 6
Fore ,, ...	1st	69 0	67 6	69 0	67 6	68 0
Australian Frozen—						
Hind Quarters	1st	76 6	76 6	76 6	76 6	77 0
Fore ,, ...	1st	67 6	70 0	69 0	68 0	69 0
VEAL:—						
British	1st	88 6	83 0	93 6	88 0	87 0
	2nd	81 0	78 6	85 6	81 0	81 6
Foreign...	1st	—	—	—	91 6	—
MUTTON:—						
Scotch	1st	—	—	—	91 0	88 6
	2nd	—	—	—	86 6	84 6
English...	1st	87 0	92 6	—	87 6	84 6
	2nd	78 6	88 0	—	81 0	78 6
Irish: Port Killed	1st	—	—	83 0	84 0	81 0
	2nd	—	—	77 0	79 6	76 6
Argentine Frozen	1st	67 0	65 0	65 6	66 6	65 6
Australian ,, ...	1st	64 6	63 6	63 0	64 0	63 0
New Zealand ,, ...	1st	67 6	64 0	—	69 0	—
LAMB:—						
British	1st	89 0	98 0	88 6	95 6	92 0
	2nd	86 6	90 0	83 6	87 0	87 6
New Zealand	1st	81 6	81 6	81 0	80 6	81 0
Australian	1st	77 0	76 0	75 0	76 6	75 0
Argentine	1st	76 6	74 6	76 6	76 6	76 6
PORK:—						
British	1st	83 6	77 0	74 6	83 6	74 0
	2nd	79 6	74 0	69 6	78 6	69 0
Foreign...	1st	—	—	—	—	—

AVERAGE PRICES of PROVISIONS, POTATOES, and HAY at certain MARKETS in ENGLAND in July, 1915.

(Compiled from Reports received from the Board's Market Reporters.)

Description.	BRISTOL.		LIVERPOOL.		LONDON.	
	First Quality.	Second Quality.	First Quality.	Second Quality.	First Quality.	Second Quality.
	s. d.	*s. d.*	*s. d.*	*s. d.*	*s. d.*	*s. d.*
BUTTER:—	per 12 lb.	per 12 lb.	per 12 lb.	per 12 lb.	per 12 lb.	per 12 lb.
British	16 0	15 0	—	—	16 0	15 0
	per cwt.	per cwt.	per cwt.	per cwt.	per cwt.	per cwt.
Irish Creamery—Fresh	147 6	145 0	145 6	142 6	147 0	143 0
,, Factory	137 0	135 0	133 6	129 6	134 0	130 0
Danish...	—	—	161 6	159 0	160 0	156 6
French...	—	—	—	—	142 0	136 0
Russian	136 0	132 0	134 6	132 0	132 0	128 0
Australian	—	—	—	—	140 6	137 6
New Zealand	—	—	—	—	146 0	144 0
Argentine	—	—	—	—	143 6	140 6
CHEESE:—						
British—						
Cheddar	97 6	90 6	101 6	100 6	100 0	94 6
			120 lb.	120 lb.	120 lb.	120 lb.
Cheshire	—	—	89 0	83 6	92 0	85 0
			per cwt.	per cwt.	per cwt.	per cwt.
Canadian	86 6	83 0	84 6	82 0	84 0	80 6
BACON:—						
Irish (Green)	98 0	95 0	94 6	89 6	96 6	92 6
Canadian (Green sides)	87 0	83 6	88 0	77 6	88 0	83 6
HAMS:—						
York (Dried or Smoked)	120 0	116 0	—	—	120 0	116 0
Irish (Dried or Smoked)	—	—	—	—	117 6	111 6
American (Green) (long cut)	74 6	71 6	74 6	71 6	75 6	73 0
EGGS:—	per 120.	per 120.	per 120.	per 120.	per 120.	per 120.
British...	14 7	13 9	—	—	15 0	14 2
Irish	13 9	13 6	13 3	12 3	13 7	13 0
Danish...	—	—	—	—	15 0	13 6
POTATOES:—	per ton.	per ton.	per ton.	per ton.	per ton.	per ton.
Early Eclipse... ...	135 0	110 0	—	—	130 0	110 0
Other First Earlies ..	145 0	96 6	126 6	95 0	126 6	106 6
British Queen ...	110 0	95 0	136 6	123 6	110 0	90 0
HAY:—						
Clover...	—	—	125 0	96 0	110 6	103 6
Meadow	—	—	—	—	104 0	93 6

AVERAGE PRICES of **British Corn** per Quarter of 8 Imperial Bushels, computed from the Returns received under the Corn Returns Act, 1882, in each Week in 1913, 1914 and 1915.

Weeks ended (*in* 1915).	WHEAT.			BARLEY.			OATS.		
	1913.	1914.	1915.	1913.	1914.	1915.	1913.	1914.	1915.
	s. d.	*s. d.*	*s. d.*	*s. d.*	*s. d.*	*s. d.*	*s. d.*	*s. d.*	*s. d.*
Jan. 2 ...	30 5	31 1	44 4	28 6	26 2	29 10	19 10	18 2	26 6
,, 9 ...	30 3	30 11	46 2	28 4	25 11	29 7	19 2	18 4	26 5
,, 16 ...	30 5	31 0	48 9	28 6	26 0	30 5	19 4	18 6	27 6
,, 23 ...	30 11	30 11	51 6	28 10	26 3	31 3	19 4	18 11	28 10
,, 30 ...	31 1	31 1	52 8	28 11	26 6	32 5	20 2	19 1	29 10
Feb. 6 ...	31 0	31 0	53 3	28 10	26 7	33 7	20 1	18 9	30 3
,, 13 ...	30 9	31 0	54 8	29 1	26 7	34 7	20 2	18 11	31 1
,, 20 ...	30 11	31 0	56 0	28 8	26 7	34 11	20 7	18 11	31 5
,, 27 ...	31 0	31 0	56 0	28 6	26 6	35 3	20 4	18 11	31 8
Mar. 6 ...	31 3	31 5	55 11	28 5	26 2	34 6	20 0	18 9	31 8
,, 13 ...	31 1	31 6	54 8	27 11	26 0	33 5	20 2	18 7	31 0
,, 20 ...	31 1	31 5	53 9	28 6	25 8	32 2	19 11	18 6	30 7
,, 27 ...	31 3	31 4	54 3	27 6	25 7	31 11	19 7	18 8	30 6
Apl. 3 ...	31 4	31 6	54 6	27 0	25 6	31 9	19 2	18 5	30 6
,, 10 ...	31 3	31 5	54 9	27 8	26 8	31 3	19 2	18 4	30 4
,, 17 ...	31 6	31 7	55 4	26 11	25 4	30 10	18 10	18 4	30 5
,, 24 ...	31 8	31 9	56 5	26 7	26 6	31 5	19 3	18 5	30 11
May 1 ...	32 2	31 9	58 3	25 11	26 0	32 7	19 6	18 5	31 5
,, 8 ...	32 6	32 2	60 5	25 9	25 6	33 3	19 6	18 9	32 4
,, 15 ...	32 10	32 7	61 7	25 4	26 3	34 0	19 9	18 11	32 5
,, 22 ...	32 10	33 0	62 0	25 3	25 10	34 1	19 11	19 0	32 8
,, 29 ...	32 7	33 9	61 11	26 1	26 1	34 8	20 1	19 4	32 7
June 5 ...	32 10	34 0	61 9	26 2	25 11	35 4	19 8	19 4	32 5
,, 12 ...	32 8	34 1	60 1	24 7	24 11	34 5	20 2	19 8	32 4
,, 19 ...	32 8	34 1	56 1	23 10	25 10	34 3	19 8	19 9	31 9
,, 26 ...	32 8	34 3	52 0	24 3	25 4	34 4	19 1	20 0	31 9
July 3 ...	33 1	34 4	49 5	25 2	24 6	35 3	21 0	19 9	31 1
,, 10 ...	33 4	34 2	50 1	25 10	24 9	34 7	19 4	20 0	31 6
,, 17 ...	33 6	34 1	52 7	24 9	24 2	35 8	20 5	19 10	31 6
,, 24 ...	33 10	34 0	53 10	24 1	24 7	35 10	20 8	19 9	32 1
,, 31 ...	34 1	34 2	55 3	24 5	25 9	36 1	20 3	19 8	31 1
Aug. 7 ...	34 1	34 9		24 9	25 2		19 0	19 1	
,, 14 ...	34 3	40 3		24 7	29 4		18 7	25 1	
,, 21 ...	33 7	38 9		26 5	29 10		18 8	24 3	
,, 28 ...	32 7	36 2		29 0	30 3		17 10	23 5	
Sept. 4 ...	31 11	36 5		30 11	30 6		17 8	23 9	
,, 11 ...	31 9	37 10		31 5	29 11		18 0	23 11	
,, 18 ...	31 7	38 3		30 9	29 5		17 11	23 8	
,, 25 ...	31 6	37 6		30 1	29 3		17 9	23 3	
Oct. 2 ...	31 3	37 1		29 9	29 1		17 10	22 9	
,, 9 ...	31 0	36 8		29 1	28 10		17 10	22 5	
,, 16 ...	30 11	36 7		28 8	28 8		17 9	22 4	
,, 23 ...	30 7	37 2		28 7	28 7		18 0	22 5	
,, 30 ...	30 1	37 10		28 2	28 3		17 9	23 7	
Nov. 6 ...	30 0	38 8		28 1	28 6		17 9	23 7	
,, 13 ...	30 1	39 8		27 8	29 0		17 11	24 8	
,, 20 ...	30 4	41 0		27 5	29 8		18 1	25 5	
,, 27 ...	30 9	41 11		27 0	30 3		18 4	25 8	
Dec. 4 ...	31 2	42 2		26 8	30 2		18 4	25 9	
,, 11 ...	31 2	42 1		26 5	29 11		18 6	25 9	
,, 18 ...	31 2	42 7		25 11	29 8		18 5	25 9	
,, 25 ...	31 0	43 3		25 10	29 9		18 4	25 11	

NOTE.—Returns of purchases by weight or weighed measure are converted to Imperial Bushels at the following rates: Wheat, 60 lb.; Barley, 50 lb.; Oats, 39 lb. per Imperial Bushel.

AVERAGE PRICES of **British Wheat, Barley,** and **Oats** at certain Markets during the Month of July, 1914 and 1915.

	WHEAT.		BARLEY.		OATS.	
	1914.	1915.	1914.	1915.	1914.	1915.
	s. d.	*s. d.*	*s. d.*	*s. d.*	*s. d.*	*s. d.*
London	34 11	54 10	24 8	36 3	20 9	32 11
Norwich	34 2	51 1	25 0	36 3	19 3	32 6
Peterborough	33 8	52 10	23 11	34 9	19 5	31 9
Lincoln	34 1	51 4	25 0	33 0	20 6	31 9
Doncaster	33 10	50 8	—	34 3	19 5	30 11
Salisbury	33 6	50 11	—	35 5	19 5	31 2

ADDITIONS TO THE LIBRARY.

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Lindsey County Council.—Bull. 2, 1914–15:—Report of the Trials with Varieties of Potatoes. (12 pp.) Lincoln, 1915. [63.512(04).]

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